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ASSESSMENT AND REMEDIATION USING THE PASS THEORY WITH CANADIAN NATIVES

by

Troy Janzen ©

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The undersigned certify they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled ASSESSMENT AND REMEDIATION USING THE PASS THEORY WITH CANADIAN NATIVES submitted by TROY M. JANZEN in partial fulfillment of the requirements for the degree of DOCTOR OF PHILOSOPHY in COUNSELLING PSYCHOLOGY.

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ABSTRACT

This dissertation research was conducted in two parts. The purpose of Part A was to examine the relationship between reading ability and cognitive abilities among a sample of 23 male and 30 female children of Cree descent. Cognitive skills were measured using portions of the Das:Naglieri Cognitive Assessment System (CAS) based on the Planning, Attention, Successive, Simultaneous (PASS) theory of intelligence (Das, Naglieri, & Kirby, 1994). Reading skills were measured using the Stanford Diagnostic Reading Test - Revised (SDRT) as well as an informal word recognition test (Word Probe). It was hypothesized that successive processing tasks would show a significant relationship with reading tasks that involved analysis and synthesis skills and that simultaneous processing would bear a significant relationship with reading comprehension. Results confirmed that a majority of reading measures were significantly correlated with successive tasks. Conversely, reading comprehension measures were significantly correlated with timed-articulation tasks and not simultaneous tasks. Discriminant analysis demonstrated that CAS subtests were able to significantly predict group membership among readers of varying ability levels. Readers were categorized into ability levels based on their performance on successive processing measures. The purpose of Part B was to examine the efficacy of the PASS Reading Enhancement Program (PREP) to improve reading skill. The sample consisted of two matched groups of 14 children selected from Part A. Each group was assigned to either a remedial or control wait-list group. Repeated measures ANOVA showed no significant interaction effects. There were significant Time effects that involved positive changes in scores over time for CAS subtests and Word Probe following PREP. Multiple regression showed that successive tasks significantly predicted phonetic analysis over time and with PREP. Likewise, simultaneous tasks predicted reading comprehension and auditory discrimination tasks. A combination of CAS subtests, representing each of the four PASS components, significantly predicted Auditory Vocabulary ability over time and with remediation. Overall, results demonstrated some weak support for the efficacy of PREP and lent stronger support for the theoretical model.

PREFACE

As mentioned in the abstract, this dissertation is divided into two main parts. The goal of Part A is to examine the relationship between cognitive skills and reading ability with a sample of Canadian Native children of Cree descent. The goal of Part B is to examine the effectiveness of the PASS Reading Enhancement Program, or PREP, with a sub-sample of children from Part A. Both parts of this research have the common elements of testing the validity of the PASS model with a culturally unique group, Canadian Native children.

The division of this dissertation into two parts made the most conceptual sense as they were really two related but separate studies. Therefore, the issues and impetus for each portion of the research will be dealt with separately. Part A consists of Chapters 1 through 5, while Part B is Chapters 6 through 10.

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PART A

CHAPTER 1

Introduction

The Issue of Cognition

Paradigm shifts occur in the field of psychology on a regular basis. Education is by no means exempt from paradigm shifts, and from time to time the shifts in thinking in both fields come together. In the field of psychology, many would agree that there has been a shift in popularity from behavioural theory to cognitive theory. Best (1989) defines cognitive psychology as, "...all processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used." (p.4) This broad definition implies that virtually any form of mental activity fits within the realm of cognitive psychology. Thus, cognitive theory has become influential in many areas of theory and practice. In particular, cognitive theory has had an impact on the areas of intelligence testing and of reading.

The problem of assessing intelligence is difficult to separate from problems of definition surrounding intelligence as a concept. Intelligence has been defined in many different ways. For example, intelligence has been defined generally as innate potential, observed behaviour, and performance on specific tests of cognitive ability (Sattler, 1990). One of the difficulties with defining intelligence in terms of innate potential is that the latter cannot be measured directly. The most widely used intelligence tests in academic and educational settings are the Wechsler and Binet scales. These scales are highly correlated with scholastic achievement (Sattler, 1990), tend to measure content over process (Royer, Cisero & Carlo, 1993), and may be biased against cultural groups including native people (Guilmet, 1983).

From a cognitive theory perspective, intelligence is typically defined in terms of information processing. Das, Naglieri, and Kirby (1994) proposed a cognitive model of assessment and remediation which has begun to have an impact in the fields of psychology and education. This model is based on Luria's (1966) notion of three functional units of the brain, and is referred to as the Planning, Attention, Successive, and Simultaneous (PASS) model. This model has been operationalized in a test called the Cognitive Assessment System (CAS) (Das & Naglieri, 1993). In contrast to traditional intelligence scales, the CAS subtests process over content, which may make it less biased in assessing cognitive processing with a distinct cultural groups such as natives.

One reason to assess a native population from a cognitive theoretical perspective relates to the belief that natives may have a unique preference for certain modes of information processing (Larose, 1991; More, 1989; Sawyer, 1991; Swisher & Deyhle, 1989; Walker, Dodd,

& Bigelow, 1989; Wauters, Bruce, Black, & Hocker, 1989). In terms of the PASS model, most of the current evidence has supported the notion that natives tend to be relatively stronger in terms of simultaneous as opposed to successive modes of information processing (Krywaniuk, 1974; Walker et al., 1989). However, there have been few studies to date focusing on cognitive ability among natives based on the PASS model and there has never been a study that includes all four components of PASS in addition to the type of processing. Thus, the first goal of the study is to describe cognitive ability of a native sample from the perspective of the PASS model.

After describing the cognitive processing of a sample of native children, the next goal of the study is to examine the relationship between Planning, Attention, Successive and Simultaneous processing, and reading.

The Issue of Reading

Most people today would agree that being able to read the dominant language of the country in which you live is valuable, regardless of your cultural background. While there may be cultural differences on the value of schooling in general, it would be hard to argue against the value of learning to read the dominant language in North America and the world today. Both individual word reading and reading comprehension are highly correlated with school learning and achievement in a majority of subjects (Daneman, 1996). Reading is the medium through which people acquire knowledge and skills in schools and it opens new doors of opportunity and helps people gain access to knowledge necessary for success in North American culture.

It could be argued that English reading skills are of equal importance for native children as for non-native children. Native children come from a heritage that has its own language. Ongoing efforts are being made to preserve and foster this native heritage in the home and the school. Yet the reality is that most native communities have adopted English as the primary language. The school systems on reservations generally follow the provincial curriculum. Also, the language of commerce in the native community is predominantly English and most families are exposed to English-speaking media influences. With such a dominance in the English language and living in the broader context of North American society, the importance of strong English reading skills is underscored.

Reading disability is the most common disability found in school-aged children, and reading problems appear to be of equal or greater prevalence in native samples (Smith, 1992). The current use of assessment instruments to define, diagnose, and characterize reading problems has been problematic at best. Many authors continue to argue about the validity of current assessment methods and of definitions of reading disability. Children are most commonly identified as having a reading disability when their reading levels are significantly lower than would be predicted by their scores on intelligence tests, such as provided by the Wechsler and Stanford-Binet scales. This definition of a reading disability is commonly referred to as a discrepancy definition. Many researchers have now shown evidence that this discrepancy definition of reading disability is unfounded and that a global intelligence score may be irrelevant to the definition of reading disabilities (Das, Mensink, & Mishra, 1990; Siegel 1989a; 1989b; 1992; Stanovich, 1989). One may ask what utility traditional intelligence measures, such as the Wechsler and Stanford-Binet scales, have in identifying, describing or predicting reading ability. At the present time it appears that tests such as these may be limited in this regard.

Perhaps an alternative conceptualization of intelligence, such as the PASS model, would have greater utility in describing reading ability and identifying and predicting reading problems. This is because the tests used to operationalize the PASS model may be more sensitive to exploring cognitive abilities regardless of culture. As Das et al. (1994, p. 23) have stated, "…tasks used to operationalize simultaneous, successive, and planning processes have functioned similarly despite wide differences in culture, language, and socioeconomic status."

The relationship between the PASS model and reading skills among natives in Canada is relatively unexplored. In the mainstream culture, it has been shown that all of the components of the PASS model are related to various aspects of reading (Das et al., 1994). However, the precise nature of this relationship remains unclear. Natives have a unique culture and may prefer certain modes of information processing. In addition, there is a wide prevalence of deficits in reading skills among natives. The factors were the impetus for the second goal of the study (i.e., exploring the relationship between cognitive abilities and reading skills among natives).

Examining the relationship between reading and cognitive skills among natives leads to the third goal of this study. The third goal is to determine whether reading ability can be accurately predicted based on cognitive ability as defined by the PASS model. Knowing the relationship between reading and cognitive ability would aid in the proper identification of children with reading problems and help in the design of appropriate remedial education plans for them.

To summarize, the goals of this study were threefold. The first goal was to describe cognitive ability of a sample of native children. The second goal was to explore the relationship between reading ability and cognitive ability with native children. The third goal was to determine whether reading ability could be predicted based on cognitive ability.

Relevance

There is a paucity of research utilizing the PASS model with this particular cultural group. With the exception of Krywaniuk's study in 1974, no study has been found that has examined cognitive processes from the theoretical framework of the PASS model. The present study would add considerably to the research on the PASS model and could provide support as to the cross-cultural validity of the measures used to operationalize the model.

Describing the cognitive functioning of a sample of native children will provide information that may lead to more appropriate educational planning. In particular, educators and curriculum developers should find this description of cognitive skills useful, especially if this native sample performs in a manner that is qualitatively different than the general population. For example, if this research confirms that native children tend to prefer simultaneous modes of information processing to successive processing then educators are faced with three basic options. On the one hand, educators may be advised to use primarily visual modes of instruction and try to provide an overall picture of a subject. Secondly, one could start encouraging early activities that promote the development of successive processing skills. Thirdly, one could utilize a combined approach that emphasizes both modes of processing equally.

Describing the relationship between reading and cognitive ability using the PASS model may aid in the identification of reading problems. Given that some authors have argued that traditional IQ measures may be irrelevant to the diagnosis of a reading disability, this research may provide further evidence that the tests used to reflect the PASS model may have greater diagnostic utility.

The PASS model appears to be sensitive to, but not biased against, variations in culture, language and socio-economic status. Therefore, the tests that reflect the PASS model may help avoid inappropriate stereotyping of culturally distinct groups such as natives. This is especially the case if PASS tests are used to help diagnose and identify learning problems. In other words, the emphasis on process over content in the operationalization of the PASS may make this a more culturally fair measure of cognitive ability.

CHAPTER 2

Literature Review

The following literature review contains four main sections. In section 1, the focus is providing background to both the present study and the PASS model. Included within this section is a review of the development and description of the PASS model and the "IQ debate". The focus of section 2 is reading, including a review of individual differences in reading. The literature that relates to reading is vast. Clearly it is beyond the scope of this dissertation to provide a thorough review of the literature relative to reading. Rather, this review will focus on the specific areas that are relevant to the present study, such as research that relates the components of PASS to reading. Section 3 will focus on relevant literature regarding the relationship between cognition, reading ability and general learning styles among native populations. In section 4, the rationale for the present study will be presented along with the specific research hypotheses.

Section 1: Background to the Study

It has already been reported that native samples have performed far below national norms on standardized tests of reading ability (Smith, 1992; Vernon, Jackson, & Messick, 1988). School wide achievement testing was completed in 1994 at the school from which the present sample was chosen. It was revealed that90% of 192 students tested in Grades 2, 3 and 4 scored below Grade level. Sixty-one percent scored two full Grade levels or more behind their current Grade placement. The student's weakest areas were found to be in the areas of phonetic analysis and reading comprehension although they were also weak in terms of vocabulary. A two-year delay in reading is clearly representative of a serious skill deficit in reading. Given the importance of reading in terms of school success alone, it is important to address some of the factors that may be contributing to these reading problems.

The purpose of this study is not to test the PASS theoretical model per se, nor to aid in the test development. Rather, the purpose is to test the application and utility of CAS in describing and understanding reading problems with this particular cultural group. At the time this research was conducted the standardization version of the CAS was already in use and the finalized version of the Das:Naglieri Cognitive Assessment System (CAS) (1993) has since been released for professional use. However, the CAS and its theory are only now receiving attention in psychology and education. For this reason, it is necessary to provide some background to how the theory was developed as well as describe the theory in detail.

Background to the theory

The PASS model of intelligence has been researched and developed over many years. Construct validity has been demonstrated for planning, successive and simultaneous processes among several unique cultural groups (Naglieri & Das, 1987). Cultural groups that have been studied include East Indian (Dash, Puhan & Mahapatra, 1985; Mwamwenda, Dash, & Das, 1984), Chinese (Leong, Cheng, & Das, 1985), Australian (Schofield & Ashman, 1986), and Spanish, (Molina, Garrido, & Das, 1997; Perez-Alvarez & Timoneda-Gallart, 2000). These studies and others provide evidence that the tasks used by the CAS function similarly despite wide differences in culture, language, and socio-economic status. However, with the exception of a study by Krywaniuk (1974) and Krywaniuk & Das (1976), there has been little or no recent research with native populations using the current CAS instrument.

Chapter 1 began with a reference to a paradigm shift toward cognitive theory. One focus for this study is the PASS model of intelligence. The PASS model was proposed in response to the more traditional theories of general intelligence. For example, both the Wechsler Scale and Lewis Terman's revision of the Binet Scales of Intelligence are based on the assumption that a single score can represent a person's innate intelligence. In fact, Lewis Terman coined the now popular term Intelligence Quotient when he and his colleagues produced the 1916 version of the Binet-Simon Scale (Sattler, 1990). Since that time, the use of a single score of intelligence, or Intelligence Quotient (IQ), has been the subject of a great deal of controversy. The next several paragraphs will review some of the literature regarding the use of traditional IQ tests. The main purpose of this is to provide some background for the impetus of the PASS model and to place it within a more familiar frame of reference. It is important to note that wherever IQ is used, it is referring to the more traditional sense of general intelligence as defined by the Wechsler and Binet Scales. Following this is a detailed description of the PASS model of intelligence as an alternative model based on cognitive theory.

The IQ Debate

There has been considerable debate regarding the role of IQ in the identification of learning disabilities, and in particular reading disability (see October 1989 issue of the Journal of Learning Disabilities). Several authors have suggested that IQ is irrelevant to the definition of a reading disability (Das et al., 1990; Siegel, 1989a; 1989b). Siegel (1989a) has attacked the perceived assumptions that a) IQ tests measure intelligence, b) intelligence and achievement are independent, c) the relationship of IQ scores with reading is linear, and (d) reading performance of individuals with reading disabilities will differ as a result of IQ. She argues that IQ scores should be abandoned in the examination of learning disabilities and that the commonly accepted IQ-Achievement discrepancy definition also be abandoned. The IQ-Achievement discrepancy definition states that when a child's reading ability is significantly below their ability as suggested by IQ, then they are said to be Learning Disabled.

On attacking the first assumption, that IQ tests measure intelligence, Siegel has received some support. For example, Stanovich (1989) agrees that the reason that IQ scores were adopted as the benchmark for the discrepancy definition of learning disabilities is the "mistaken belief" that IQ tests measure intellectual potential. Stanovich also agrees with Siegel that reading disability would be better defined in reference to pseudoword reading or the ability to read nonsense words.

Leong (1989) also agrees that IQ tests do not measure potential but is careful to point out that examination of the early works on intelligence make no claims that intelligence measures innate potential. Leong (1989) also says that Siegel's analysis of the subtests of traditional IQ tests like the WISC-R, and her attack on the over-reliance on speed in IQ tests, ignores current evidence. For example, recent research has shown that rapid automatic naming ability is a necessary though insufficient condition for reading (Badian, 1994; Jorm & Share, 1983). Perhaps the main difficulty is one of semantics. As Stanovich (1989) states, "Siegel's argument about the fairness of IQ tests to children with LD (Learning Disability) is intricately bound up with conceptions of intelligence, definitions of LD, and the psychometrics of testing in some very tricky ways." (brackets mine, 1989, p.490).

Torgesen (1989) also disagrees with Siegel on several fundamental points. First, he points out that there is ample evidence to demonstrate a relationship between phonologically based reading skills and IQ. Second, he takes issue with Siegel's statement that the existence of samples of children who have IQ's below 80 yet have average reading skill "proves" that low IQ is not causally related to reading problems. Torgesen points out that this simply means that IQ is not a sufficient cause of poor reading and other factors such as teaching, motivation, and home support, among others, may have helped compensate for low IQ. In other words, IQ is only one factor among many other possible causal factors for a reading disability. Naglieri (1989) attempts to bring closure to this issue by advocating in favor of the relevance of cognitive processes for explaining reading and poor reading and the irrelevance of IQ.

On attacking the second assumption, that intelligence and achievement are independent, Siegel has found general agreement from the field. Many psychologists in the field of assessment recognise that traditional IQ tests are highly correlated with measures of school achievement (Sattler, 1990). Others have agreed with Siegel that reading disability can both affect and be affected by general intelligence, that is they are interdependent (Torgesen, 1989). If this is the case, Das (1991) has argued that IQ test scores, when interpreted as reflecting true intelligence, discriminate against disadvantaged children. Traditional IQ tests, such as the Wechsler scales, offer a rather narrow definition of intelligence. For example, the Verbal scale of the Wechsler Intelligence test tends to measure such skills as specific knowledge, vocabulary, expressive language and memory. Siegel points out that reading disabled children have problems with some or all of these skills (1989a).

While the debate goes on, Siegel's argument against the use of IQ test scores in the definition of reading disability raises important and valid questions for both researchers and practitioners who work with these populations. Further, both she and Stanovich point out that the burden of proof lies with those who hold that the cognitive processes in individuals with LD and low IQ scores are different from individuals with LD and high IQ scores. To date, IQ tests have been relatively ineffective in contributing to our understanding of many discrete cognitive abilities including reading problems (Siegel 1989a; 1989b; 1992).

Since the 1930's the popular Wechsler scales have changed little in terms of which subtests were included and the types of scores that are derived from the test. Even Wechsler himself recognized that intelligence test scores are not identical with what is meant by intelligence. As Sattler (1990) points out, "Tests of intelligence, achievement, ability, or aptitude are, for the most part, measuring similar abilities; the names merely reflect the aspect that has been selected for investigation" (p.45). Thus, IQ test scores tend to provide description, be content or knowledge-based, and are often used to evaluate the effectiveness of instructional goals, rather than helping us explain behaviour.

Assessment in a cognitively-based system, in contrast to the traditional IQ, has the additional goals of evaluating a student's progress in a developmental model of cognitive skill attainment, assessing cognitive processes, and providing diagnostic information (Royer, Cisero, & Carlo, 1993). That is, the emphasis is on process where students are examined in relation to their own stage of cognitive development in addition to developmental comparison to peers. The emphasis on assessing cognitive processes, which are considered higher-order and therefore causally linked to micro-skills (such as reading), may allow for greater utility in diagnosing and pinpointing an area, or areas, that could contribute to a particular cognitive deficit (Das et al., 1994). This gives it a considerable advantage over traditional IQ tests in contributing to the understanding of reading and reading problems

Given the above stated problems with traditional IQ measures and the advantages of a cognitive-based method of assessment, theorists and psychometricians have made efforts to produce a test that is based on a well-researched cognitive theory. One such test is the Das:Naglieri Cognitive Assessment System (CAS), which is the operationalization of the PASS model of intelligence. The next segment describes the PASS theoretical model in detail.

The PASS Model of Assessment

The PASS model is based on Luria's (1966) notion of three functional units of the brain (see Das 1999b for a recent review). These units are both physiological and conceptual in nature. That is, Luria proposed that the brain could be divided into three main units that are defined mainly by their function but also by their general brain location. The units as defined by Luria included an attention or arousal unit that roughly corresponded to midbrain centers including the reticular activating system. The second functional unit is responsible for retrieving, storing and processing information and roughly corresponds to the parietal and occipital lobes of the brain. The third functional unit is responsible for planning, impulse control, regulation of voluntary activity, and linguistic functions such as spontaneous speech. The third unit roughly corresponds to the frontal lobe of the brain. The PASS model was derived from this foundation. Presented below is a more detailed explanation of each of the components of the PASS model. For a more thorough description of the theory the reader is referred to Das, et al. (1994).

Planning, as defined in the PASS model, allows a person to "analyze cognitive activity, develop some method to solve a problem, evaluate the effectiveness of a solution, and modify the approach used. These processes are necessary when an efficient and/or systematic approach to solving a problem is required" (p.428). Thus, planning revolves around problem solving, with efficiency as the central way to measure successful planning. Efficiency generally refers to the ability to perform activities in less time and taking the least amount of steps to complete the activity (Royer et al., 1993). In order for an individual to plan, a person must be able to process information that ultimately requires sufficient attention and arousal devoted to the task. Thus, planning is closely related to arousal and attention, although planning relies on all the components of the PASS model in order to function. Many other terms or concepts have also been postulated to relate to planning. Some of these include, organizing information, goal-directed behavior, control of intentions, developing and shifting sets, maintaining a course of action despite interference, utilizing feedback to facilitate problem solving, producing language with fluency and automaticity, and exploiting the phonemic aspects of words (Das, et al., 1994; Kelly, Best, & Kirk, 1989; p. 277). As shall be seen in a later section, the key element for the operationalization of planning are tasks that require the development of an efficient system for completing a relatively simple task.

The next component of the PASS model involves arousal and attention. Arousal is an integral and necessary part of attention. In fact, for any purposeful and intelligent activity to occur, arousal and attention are requisite. Arousal refers to a person's state of alertness or wakefulness. It is more of a physiological state as opposed to a cognitive state. For example, arousal is low when someone is drowsy and high after drinking coffee or after receiving a scare.

Attention, on the other hand, is a more complex voluntary cognitive activity that is required for any meaningful problem solving. Within the PASS model two broad classes of attention are distinguished, namely selective and sustained attention. Selective attention can be further subdivided into focussed or divided selective attention. Focussed selective attention refers to how well a subject can focus on relevant stimuli while ignoring irrelevant stimuli. A common example of focussed selective attention is when a student can focus on their homework when the television and radio are on in the background. For a divided attention task an individual shares attention resources between two or more sources of information or kinds of mental operations. A good example of a divided attention task is the everyday activity of driving, where a driver must focus simultaneously on the internal environment of the car (e.g. steering wheel, hum of engine, resistance of gas pedal, etc.) and the external environment (e.g. a stop sign ahead).

In the PASS model, selective attention is further distinguished in terms of whether selective attention occurs at the time information is received and stored in the brain (receptive) or during the response or expression (expressive). An example of a receptive attention task is a dichotic listening task. This is where two separate pieces of auditory information are presented simultaneously to opposite ears. An example of a dichotic listening task is the Dichotic Digits Test (Musiek, 1983) where an individual hears two digits in each ear simultaneously and is asked to repeat all four digits. An example of expressive attention, on the other hand, is seen in the more widely known Stroop test. The Stroop test presents three color words (red, green and blue) printed in the same three colors of ink. For example, the word "red" may be printed in green ink. The task requires the child to name the color of the ink while inhibiting the automatic response of reading the word. It is this requirement of inhibiting the expression of one piece of information (i.e., the color word), while selecting and expressive another piece of information (i.e., the color of the ink) that make this task both selective and expressive.

Sustained attention, on the other hand, refers to the maintaining of attention to a single source of information for an unbroken period of time. Another synonymous term for sustained attention in the literature is vigilance. Air traffic control operators, who are required to monitor radar screens for extended periods of time, require good vigilance skills.

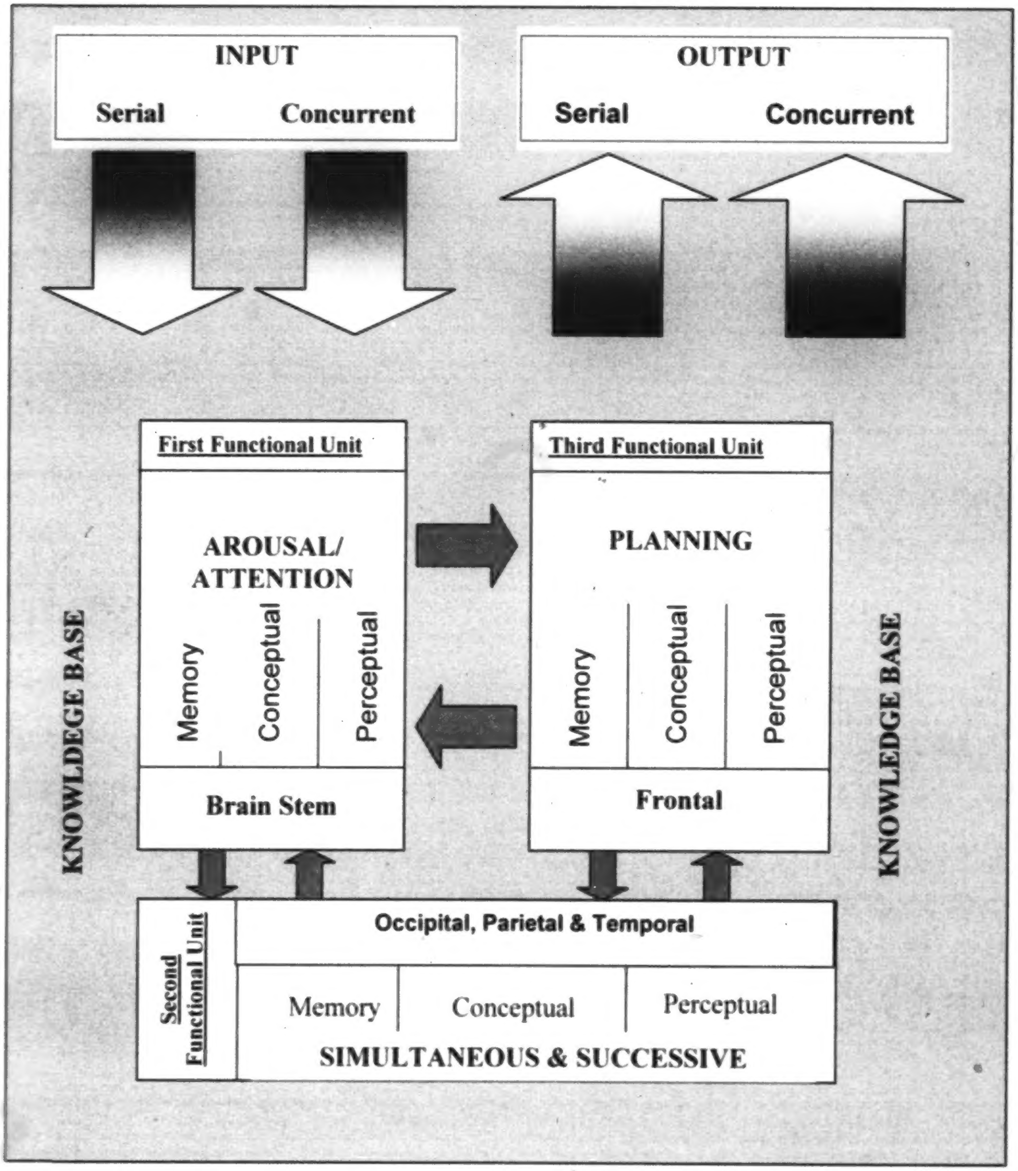
The next components of the PASS model, namely successive and simultaneous processing, are responsible for retrieving, storing, and processing information. Successive processing in the PASS model has been defined as "... the integration of stimuli into some specific series where the elements form a chain-like progression" (Naglieri, Das, & Jarman, 1990; p. 427). Simultaneous processing on the other hand, is defined by the same authors as "... the integration of stimuli into groups, often through the recognition that a number of stimuli share a common characteristic, and therefore these aspects require that the stimuli be related to one another" (p.427). The key difference between these two processes is that in simultaneous processing, elements can be interrelated in several ways while in successive processing they are only linearly related. An example of successive processing might be when a novice reader encounters a novel word and tries to read it phonetically, one letter at a time from left to right. A successful reader will process each letter in sequence until they establish a correct pronunciation. On the other hand, an example of a simultaneous process includes the ability to read a novel word by utilizing context cues within a passage or recognizing the word or parts of the word from memory.

The next question is how do each of these four components operate during any cognitive activity? Das et al. (1994) state that the PASS components all work dynamically and interactively. The components are dynamic in that they rely on and respond to the knowledge and experience of the individual. Thus knowledge acts as a moderator for processing. The operation of the PASS model is illustrated in Figure 1.1. Figure 1.1 illustrates the interaction of the different elements of the model. This shows how the elements are all related and yet maintain their independence from one another. As Das, et al. state, "Effective processing is accomplished through the interaction of knowledge with planning, attention, simultaneous, and successive processing as demanded by the particular task" (p.19).

The input and output parts of the model indicate that information can arrive through any sensory modality, but they enter either serially (i.e., over time) or synchronously (i.e., concurrently). For example, auditory information is often presented serially while visual information is frequently presented concurrently. Regardless of the method of presentation, the type of processing (i.e., successive or simultaneous) is dictated by the requirements of the task and not by the way it is presented.

Figure 1.1

The PASS Model of Ability (Adapted from Das, et al., 1994, p.21)


INPUT
Serial
Concurrent
OUTPUT
Serial
Concurrent
First Functional Unit
AROUSAL/ ATTENTION
Memory
Conceptual
Perceptual
Brain Stem
Third Functional Unit
PLANNING
Memory
Conceptual
Perceptual
Frontal
KNOWLDEGE BASE
KNOWLEDGE BASE
Second Functional Unit
Occipital, Parietal & Temporal
Memory
Conceptual
Perceptual
SIMULTANEOUS & SUCCESSIVE

The final feature of note within Figure 1.1 is the arrows that connect the functional units. These arrows show the strength of relationship as indicated by the size of the arrow. Thus, the planning and the arousal/attention components purport to have a stronger relationship with each other than they do with either mode of processing (i.e., successive or simultaneous).

In summary, the four components of the PASS model include Planning, Attention, Successive and Simultaneous processing. These components all work interactively but also respond to changes in a person's experience and knowledge base.

Section 2: Accounting for Individual Differences in Reading

With this basic understanding of the PASS model and their components, we now turn to reading, which is the cognitive skill that is the focus for the present study. Phonology may be the most important aspect of reading. Phonology refers to the phonetics or phonemics of language. Phonetics refers to spoken language and speech sounds while phonemics refers to the smallest units of speech that serve to distinguish between one utterance and another. In the research the phonological aspects of reading includes the naming of pseudowords, letter and word naming, the recognition of phonemes, phonemic segmentation, and verbal memory.

The Role Of Phonology In Accounting For Reading Problems

Pseudo-word Reading. Reading of pseudowords requires the ability to convert spellings into their corresponding sounds. The conversion of spellings into sounds could be considered to be one of the primary processes in early reading. The inability to convert spellings into corresponding sounds, or the accurate naming of pseudowords, has been shown to be the most reliable indicator of reading problems (Badian, 1994; Bowey, Cain, & Ryan, 1992; Bradley, 1988; Byrne, Freebody, & Gates, 1992; Carr, Brown, Vavrus, & Evans, 1990; Jorm & Share, 1983; Manis & Morrison, 1985; Stanovich & Siegel, 1994). This relationship between spelling to sound conversions and reading skill is so strong that it has been referred to as "the defining feature of reading disability" (Share & Stanovich, 1995a, p.7).

Despite the fact that spelling to sound conversion is the defining difference between skilled and less skilled readers, there is considerable controversy surrounding the proper theoretical explanation for this process. The most common explanation for the process of spelling to sound conversions is found in the so-called dual-route models, which postulate a direct visual access path and an indirect phonological route to where language information is stored in the brain. This model, along with other models of reading acquisition, is further explained in Chapter 6.

While difficulty with spelling to sound conversion practically defines poor individual word reading, researchers have also examined the process by which the brain handles sound-symbol representations. Even at this more cognitive level of analysis, it has been relatively easy to find associations between phonological processes and individual word reading. For this reason, some researchers have referred to phonological processing problems as the core deficit that characterizes developmental dyslexia (Jorm & Share, 1983; Share & Stanovich, 1995a; Stanovich, 1988).

Rapid Articulation. One area of phonological processing that has shown reliable differences between disabled and non-disabled control readers is the rapid articulation of words or pseudowords (Blachman, 1994; Das, 1993; Das, Mensink, & Mishra, 1990; Das, Mok, & Mishra, 1994; Das & Sui, 1989; Sunseth & Bowers, 1996). An example of a rapid articulation task is found in the Speech Rate subtest of the CAS. This task requires the individual to rapidly repeat three one-syllable words (e.g. man, cow, key) in succession ten times. Usually, disabled readers make more errors and are slower at such tasks (Lovett, 1987).

Another closely related task to the rapid oral repetition of words is Rapid Automatized Naming (RAN) (Denckla & Ruddell, 1976). With RAN, it is first established that a subject can name five letters, numbers, colors, and objects. Subjects are then timed on their ability to name these four types of stimuli individually when each type appears as 10 repetitions of five items. Poor readers have consistently performed more poorly on this sort of task when compared to non-disabled controls (Cornwall, 1992; Jorm, Share, MacLean, & Matthews, 1986; Watson & Willows, 1985). This deficit in rapid naming ability does not appear to be simply the result of poor reading and is independent of knowledge of word meanings (Ellis & Large, 1987; Felton & Brown, 1990; Jorm et al., 1986; Share, Jorm, MacLean, & Matthews, 1984; Share & Stanovich, 1995a).

In general, these rapid articulation and naming tasks are sequential in nature and clearly contain an articulation component. The question then becomes, do deficits in rapid articulation result from deficits in speech, phonological processing or some higher order cognitive process?

The answer to this complex questions depends primarily on one's theoretical viewpoint. However research has clearly shown that rapid articulation tasks discriminate good and poor readers and these articulation tasks are best represented by the higher order skill of successive processing. For example, Das, Mensink and Mishra (1990) showed that sequence repetition, naming time, and Speech Rate as well as the Stroop task (which involves an articulation component) all discriminated between good and poor readers. They suggest that deficient speech-related processes may be a central problem for poor readers and that these articulation tasks are best represented by the higher order skill of successive processing.

Phonemic Segmentation. In addition to differences in the above basic phonological processes, the ability to segment a word or non-word into phonemes, or single units of speech, is also difficult for problem readers (Bowey, et al., 1992; Content, Kolinsky, Morais, & Bertelson, 1986; Share & Stanovich, 1995a; Stanovich, 1992; Vellutino & Scanlon, 1987). This sort of skill is referred to as phonological segmentation. An example of a phonological segmentation task is when a reader is asked to divide words into their correct phonemic units. For example, the word "Cat" has three phonemic segments, (*kuh-a-tah*) yet it has only one acoustic segment which is approximately the size of a syllable. Another example of a phonemic segmentation task is when someone is asked to say a word and then either delete the beginning or ending sound of the word. For example, if you were given the word "Bingo" and asked to delete the first sound it would be pronounced as "-ingo". Fox and Routh (1976) have even shown that children who can recognize phonemic segments in speech may very well have an easier time making sense of and mastering component skills such as blending in beginning reading. However, there is some question as to whether the problems in the ability to segment words phonetically are a result or cause of reading problems. Some researchers have provided evidence that the relationship between phonological segmentation and reading is a matter of reciprocal causation (Ehri, 1979, 1984, 1985; Perfetti, Beck, Bell, & Hughes, 1987). That is, possession of phonological skills, such as phonemic segmentation, helps children learn to read, but it is also true that learning to read helps improve phonological skills (Ehri, 1979).

Summary. Essentially, there is strong evidence that poor readers, as a group, are impaired on a wide range of cognitive tasks in the phonological domain. This appears to be true whether looking at the more obvious aspects of phonology such as rhyme, Speech Rate, serial naming, and short term retention of verbal information, or when looking at the deeper forms of phonological processing such as phonemic segmentation. There is even growing evidence for a causal link leading from phonological processing to early reading acquisition. Most of this evidence comes from longitudinal studies where phonological skills were actively taught to pre-schoolers (Bradley & Bryant, 1988; Byrne & Fielding-Barnsley, 1991, 1993; Cunningham 1990; Hatcher, Hulme, & Ellis, 1994; Lundberg, Frost & Peterson; 1988; Lundberg, Olofsson & Wall, 1980; Olofsson & Lundberg, 1983; Torgesen, Morgan & Davis, 1992). However the question still remains as to whether some underlying, higher order cognitive process can explain links in phonological processing to reading. As we shall see in the section that describes the research on the PASS model and reading, there is some evidence to suggest that all of these phonological deficits may be parsimoniously explained as a result of a general successive processing deficit.

In the next portion is a review of the research relating to working memory. Clearly, memory and attention are important for any sort of cognitive activity including reading. Since working memory is closely related to attentional processes, and since attention is a key component of the PASS model, this brief review is presented.

The Role Of Verbal Working Memory In Accounting For Reading Problems

One of the difficulties with examining the role of working memory in any cognitive activity has been one of definition and finding measures that accurately reflect this skill. Baddeley (1992) provides one of the better descriptions of working memory. He proposed a Tripartite Model to explain working memory which is comprised of an attentional component, which acts as the central executive, an articulation component that manages the speech based information, and a visual-spatial sketchpad. The articulation component and the sketchpad act as mechanisms for recirculating auditory and visual information. Working memory provides us with a temporary knowledge base or a set of currently active information.

In relating these components to the PASS model, Das et al. (1994) suggested that while auditory information is by nature processed successively and visual information processed simultaneously, both types of processing occur in working memory. That is, successive and simultaneous processes are seen as complimentary and both types of processing may be applied to information to be stored, whether verbal, spatial, episodic or semantic in nature.

Regardless of definition of working memory, there is abundant evidence that disabled readers have difficulty with short-term retention of verbal material when presented aurally or visually (Baddeley, 1982; 1986; 1992; Byrne & Shea, 1979; Carr, et al., 1990; Cornwall, 1992; Gathercole & Baddeley, 1990; Siegel, 1992; Siegel & Ryan, 1988; 1989; Watson & Willows, 1995). While all of these researchers found reliable differences between disabled and non-disabled readers, there was some disagreement as to whether subtypes of disabled readers can be distinguished according to working memory tasks. For example, Siegel (1992) found that both poor individual word readers and dyslexics performed poorly on a verbal memory exercise and could not be distinguished from one another. Conversely, Watson & Willows (1985) proposed three subtypes of poor readers who all had symbolic processing/memory difficulties which occurred in combination with visual processing deficiencies (subtype 2) and with deficits in both visual processing and rapid automatized naming (subtype 3). The above two studies highlight the conflicting evidence about the utility of working memory tasks to distinguish between subtypes of poor readers. One possible explanation for this conflicting evidence may relate to attention, which is the central executive of working memory. That is, without controlling for attention, the above studies may have had a different result.

The Role Of Visual Deficits In Accounting For Reading Problems

The idea that visual processing deficits are related to reading problems was once quite popular but has since been de-emphasized in several major reviews (Vellutino, 1979; Share & Stanovich, 1995a; Stanovich 1986). A visual processing deficit is a difficulty with processing or understanding the visual representation of words. That is, incorrectly seeing the letters or coding them inappropriately within verbal memory. Essentially, the evidence has failed to adequately support the hypothesis that there is a visual subtype of reading disability. Studies that have suggested a visual subtype exists (Lovegrove, 1992; Lovegrove & Williams, 1993) have faltered under the scrutiny of replication studies (Hayduk, Bruck & Cavanagh, 1992). While the possibility still exists that there is a visual subtype of reading disability, the prevalence of such a subtype is either very small or else always co-occurs with a phonological deficit.

PASS and Reading

All of the components of the PASS model have been studied in relation to reading and reading problems. While initial studies tended to focus more exclusively on successive and simultaneous processing, later studies also included planning and attention. Each of these processes will be examined as it relates to reading and reading problems.

Problems in individual word reading are most often associated with poor performance in successive processing especially in early Grades (Carlson & Das, 1992; Das, Mishra, & Kirby, 1994; Das, Nanda, & Dash, 1996; Das & Siu, 1989; Kirby, Booth, & Das, 1996; Kirby & Das, 1990; Kirby & Robinson, 1987; Kraft, 1993; Parilla & Kirby, 1998; Snart, Das & Mensink, 1988). Conversely, reading comprehension tends to be significantly related with simultaneous tasks after Grade 3 or 4 (Das, et al., 1994; Mahapatra, 1990; Parilla & Kirby, 1998). Planning is thought to be a significant process that underlies reading achievement in general while attention is clearly required for any cognitive task but does not seem to be specifically related to reading disability (Das 1993a; 1993b). These statements provide the basic findings to date regarding PASS and reading ability. What follows is a more detailed description of the research including each of the PASS processes beginning with research about successive processes.

There are reliable differences in the performance on successive processing tasks between reading disabled and non-reading disabled groups (Das, Mishra, & Kirby, 1994; Kirby, et al., 1996; Perez-Alvarez & Timoneda-Gallart, 2000). For all of these studies, this finding held true regardless of the subjects' non-verbal IQ as measured by the WISC-R or Matrix Analogies Test. Kirby et al. (1996, p. 454) state that, "Successive processing emerges in this and previous studies as an important factor in the development of skilled reading. It is possible that successive processing is ether a prerequisite for phonological coding or a critical component in its application to reading."

Tasks used to measure successive processing have commonly contained an articulation component. Successive processing tasks with an articulation component include Naming Time and Speech Rate. Naming Time involves naming common objects. Speech Rate requires the subject to rapidly repeat three phonetically dissimilar but common words 10 times in succession (e.g. man-cow-key). These tasks have been utilized in several studies and have shown to reliably predict aspects of phonological coding and word decoding skills (Das & Mishra, 1991; Das, Mok, & Mishra, 1994). In Das and Mishra's 1991 study, they found that Naming Time best predicted individual word reading skills followed by Speech Rate. They also utilized a working memory task in their study that did not add to predictability. They concluded that a latent variable involving two elements (i.e., phonological activation and articulation) would lead to poor memory span as well as poor reading. These findings were replicated by Das, Mok & Mishra (1994) with a sample of 8 and 10 year old poor and average readers. Das et al. also found that Naming Time and Speech Rate were dependable measures of phonological coding skills and were actually better predictors of word decoding than tasks of phonemic segmentation and word recall.

In several studies, simultaneous processing has shown significant relationships with both individual word reading skills and reading comprehension (Das, Cummins, Kirby, & Jarman, 1979; Das et al., 1996; Leong, et al., 1985; Mahapatra, 1990; Parilla & Kirby, 1998). As was the case for successive tasks, there are reliable differences between children with reading problems and chronological age control groups (Kirby, et al., 1996; Mahapatra, 1990; Parilla & Papadopoulos, 1996). Kirby et al. (1996) also found that two groups of children with reading disabilities, one group with high IQ and the other with low IQ, had significant differences on simultaneous processing measures. However, they state that this finding may be spurious as the groups were pre-selected to differ based on their non-verbal IQ as measured by the Matrix Analogies Test (Naglieri, 1985). The Matrix Analogies Test was also one of the simultaneous processing measures used in the study.

A more recent study by Parrila and Papadopoulos (1996) showed that a group of Grade 1 children displaying early reading difficulties (based on Word Attack and Word Identification) consisted of two subgroups. One subgroup consisted of participants who were performing at a significantly higher level than the other subgroup on most cognitive tasks, "particularly in those measuring simultaneous processing." (p.2). Relative to a chronological control group, the first subgroup was significantly different on only a planning task and two successive tasks. In contrast, the second subgroup differed from the control group on all but one cognitive processing tasks (i.e., Planned Search).

Kirby (1988) offers a conceptualization of how successive and simultaneous processing occur in reading. In Kirby's model, successive and simultaneous processing, as they relate to reading, are arranged in eight distinct hierarchical levels of increasing complexity. These eight levels include features, letters, sound or syllable units, words, phrases, ideas, main ideas and themes. At each level, items of information are recognized (simultaneous processing) and ordered (sequential processing) so that the next higher-level unit can be recognized (simultaneous).

Regarding planning and attention, Das, Mishra, and Kirby (1994) found that both receptive and expressive attention tasks, in combination with successive tasks discriminated between dyslexic and non-dyslexic students. Of interest was that they failed to find an association between the planning or simultaneous processing tasks and reading. Conversely, Little, Das, Carlson, and Yachimowicz (1993) found that two factors, including a planning/attention and successive processing factor, explained 65% of the variance in word reading skills (i.e., individual word reading and word attack). The Planning/Attention factor consisted of several tasks including Planned Connections, Expressive Attention and Receptive Attention. The successive processing factor consisted of Word and Sentence Repetition, Speech Rate, and Sequence Repetition. Both of these studies confirm the importance of expressive and receptive attention skills in relation to reading achievement. In fact, Little et al. (1993) suggest that the planning/attention factor was a better predictor of Word Skills than the successive processing factor. It is possible that differences between these studies in terms of samples, methods of analyses, and tasks used may account for variable findings. Conversely, the fact that the tasks used for the planning/attention factor were all timed may have contributed.

Das et al. (1990) found that the Stroop Color-Word Test, an expressive attention measure, helped discriminate between good and poor readers. The Stroop Color-Word Test essentially has three components. First a subject has to rapidly name colors, and then rapidly name color-words (i.e., red, blue, green and yellow). In the final condition, subjects are presented with color words written in different colors of ink. The task in the final condition is to name the color of ink and suppress the reading of the word. Das (1993b) replicated this finding when he found that several selective attention measures with an articulation component helped distinguish between disabled Grade 5 readers, average Grade 5 readers and average Grade 3 readers. In the 1993 study, Das used

Posner and Boies' (1971) physical and name matching tasks as well as the Stroop Color-Word Test. Specifically, he found that disabled readers were poorer at the name matching and color-word naming but were average in terms of color naming and physical matching.

In summary, studies have consistently shown a strong relationship between successive processing skills and individual word reading. Simultaneous processing tasks have most consistently shown relationships with reading comprehension tasks especially for children beyond Grades 3 and 4. A factor consisting of planning and attention has a significant relationship with individual word reading and word attack and with school-based achievement in general. However, planning and attention tasks have not consistently shown a significant relationship with reading. One exception to this are expressive attention tasks, which, by virtue of their articulation component, have more consistently shown a significant relationship with phonological tasks involved in reading.

The question now becomes how do Canadian natives with varying reading ability perform on the CAS? More specifically, does the PASS assessment system have the power to discriminate between native readers of varying levels of proficiency? Understanding the cognitive components that relate to levels of reading achievement may help to establish early intervention programs, to design effective remediation programs, and to provide general information about the process of reading.

Now that the review of the literature regarding the PASS model and its relationship with reading has been completed, it is important to explore this same relationship for the population chosen for the present study. Clearly native people are a heterogeneous group represented by many cultures, languages and traditions. The sample chosen for this study comes from the reservation community of the Cree First Nation. The Cree First Nation is considered part of the larger group referred to as Plains Indians. The next section will focus on understanding cognition and learning in a native population.

Section 3: Understanding Cognition and Learning From a Native Perspective

Clearly reading problems go beyond the boundaries of culture. However, one must carefully examine the degree to which culture affects reading skills. From several studies, we already know that one's cultural schema can affect the metacognitive strategies used for reading (Davidson, 1989; Pritchard, 1990). The effect of culture on reading ability is unique for Canadian natives. Coming from a history of literacy and education different from European Canadians, as well as encountering economic and cultural discrimination and disruption, it is not very surprising that many native children have difficulty reading the English language.

To understand more about reading problems among natives, what is needed is some way to conceptualize and assess their cognitive skills with little interference from the cultural biases inherent in many IQ tests. The CAS, which is based on the PASS model, appears to suit this purpose. However, before we can begin to examine native cognitive patterns as they relate to reading, it would seem useful to review the relevant literature on native learning styles and reading.

Native Learning Styles

Considerable research has been done on native learning styles, as the assumption has been that natives learn in a qualitatively different manner than non-natives and Caucasians in particular. Learning style has been defined in several different ways. For the purposes of this thesis, the definition as presented by More (1989, p. 17) is used, where learning style refers to: "The characteristic or usual strategies of acquiring knowledge, skills and understanding by the individual." In other words, learning style is roughly equivalent to the preferred mode of information processing.

The most common assumptions about native learning style are that natives tend to be relatively stronger in terms of visual or observational modes of learning (Larose, 1991; More, 1989; Sawyer, 1991; Swisher & Deyhle, 1989), that most native cultures emphasize a non-competitive or collaborative learning environment (Swisher & Dale, 1989; Walker, Dodd, & Bigelow, 1989; Wauters et al., 1989) and that competence should precede performance (Sawyer, 1991; Swisher & Dale, 1989).

In terms of the successive and simultaneous processing, Walker, Dodd and Bigelow (1989) showed that a majority of capable native American adolescents (from Northern Cheyenne and Crow nations) preferred a learning style that involves organizing verbal information simultaneously. A simultaneous processing learning style was evidenced by higher scores on a learning preference scale in favor of a "Patterned Symbols" approach to learning. The authors state that, "These learners draw personal symbolic relationships between what they know and the new information" (p.64).

It has also been found that native students perform relatively better on tasks that involve a simultaneous mode of processing (Krywaniuk & Das, 1976). There has also been a consistent finding that natives have a relative cognitive strength for visual and spatial skills as opposed to verbal skills (Kleinfeld & Nelson, 1991). As will be examined in Part B of the current study, the PASS Reading Enhancement Program (PREP) incorporates small group instruction, highly visually stimulating materials, and opportunities for personal interpretation or inductive learning in a non-competitive environment. These components may be ideally suited for individuals who prefer and are more capable in terms of visual, simultaneous or patterned symbol learning approaches.

The following questions remain. Do native children have a cognitive "style" or preferred mode of operation, especially when it comes to reading? Do Cree children favour one form of information processing over another? What are the cognitive patterns of strengths and weaknesses for readers of varying ability? These are questions to be addressed in the present study.

Section 4: Rationale and Goals of the Present Research

Native populations have generally been found to have low levels of academic achievement relative to national norms, especially in reading (Leveque, 1993). For the present sample of children, recent school-wide testing revealed deficits of up to two Grade levels for a majority of children. Current evidence would suggest that some insufficiency in terms of phonological processing would explain these deficits. There are many possible explanations for why these phonological processing problems exist. The PASS model proposes that a higher order cognitive factor, or combination of factors, may explain the problems in phonological skills.

Current research with the PASS model suggests that poor individual word reading is most strongly related to successive processing, while reading comprehension problems are most often associated with simultaneous processing. While these conclusions have generally been supported by research the current operationalization of the PASS model, or the Cognitive Assessment System (CAS), has never been tested for various forms of validity with a native population (Messick, 1989). Information about the construct and face validity of the PASS model using the CAS may be derived from exploring its utility with a native sample.

The research evidence also suggests that native populations have a qualitatively different mode of information processing. More specifically, there is evidence that natives generally prefer and do better at tasks that involve simultaneous over successive modes of processing (Krywaniuk, 1974; Krywaniuk & Das, 1976; Walker et al., 1989). A secondary goal of Part A is to test whether this holds true for this sample of native children.

To summarize, the goals of Part A of the research include:

- To describe a sample of native children in terms of their cognitive processes according to the PASS model.
    - Relative to each other (within subjects)
    - Relative to a normative sample
- To describe reading ability of a stratified random sample of native children.
- To determine the relationship between CAS and reading with native children.

- To determine whether good readers are different from, or can be discriminated from poor or very poor readers based on selected measures of the CAS.

Despite all the criticisms regarding the use of IQ test scores, for the purposes of the present study, something closely akin to a traditional IQ measure was still included. That is, the Canadian Test of Cognitive Skills (CTCS) was utilized to provide an overall IQ score or measure of g-factor intelligence. The purpose of this inclusion was to confirm or refute past literature regarding the importance of IQ in identifying individual differences in reading. Also, a traditional IQ measure has not been examined for its importance, or lack thereof, in determining individual differences in individual word reading and reading comprehension. Lastly, a traditional IQ measure will provide some degree of description of the native sample and serve as a benchmark for comparison purposes to other tests utilized in this study.

Hypotheses

For part A of this research, there are several research hypotheses that come directly from past research:

1. There will be a significant relationship between various subtests of the Cognitive Assessment System and reading measures. There are two more specific sub-hypotheses that can be derived from this general hypothesis.
   a. There will be a significant relationship between the two subtests that involve phonetic analysis skills on the Stanford Diagnostic Reading Test (SDRT) (i.e., Phonetic Analysis or Auditory Discrimination) and the two successive tasks on the Cognitive Assessment System (CAS) (i.e., Word Series or Speech Rate).
   b. There will be a significant relationship between the Reading Comprehension subtest from the SDRT and the simultaneous tasks of Figure Memory and Matrices of the CAS.
2. There will be a statistically significant difference between readers of varying vocabulary ability (i.e., very poor, poor, and average) on the various CAS subtests.
3. Group membership (i.e., very poor, poor, or average vocabulary ability) will be successfully predicted, by greater than chance, based on individual's performance on CAS subtests.
4. There will be a statistically significant difference between readers of varying individual word reading ability (i.e., low or high) on the various CAS subtests.

5. Group membership (i.e., low or high individual word reading) will be successfully predicted, by greater than chance, based on individual's performance on CAS subtests.

CHAPTER 3

Methods and Procedures

The Setting

The present population was chosen from a reservation site in Alberta, Canada. The school that participated in this study consists entirely of children from the reserve and is run by the local band. The school has children from Grades 1-4 with Kindergarten and Grades 5-11 housed in a separate but adjacent school.

Demographically, the reservation consists of approximately 12,000 people. Economically, the main sources of income come from oil royalties and farming. Socially, the same problems that exist in most rural centers exist on this reservation. However, some social problems have a higher prevalence within the reservation. Estimates of suicide, alcoholism (and Fetal Alcohol Effect), crime, unemployment, some health problems (e.g. Diabetes), and teen pregnancy, are all higher than national prevalence rates (Medical Services Branch Community Survey, 1998).

The reservation is also rich with culture. Aspects of Cree culture are explicitly taught in schools and maintained in people's homes. This includes Cree language instruction, which begins in Kindergarten. Efforts are now being made to establish Cree immersion schools to help children master their mother tongue. A Cree dictionary has been created to help with this purpose (LeClaire & Cardinal, 1998).

Sample Selection

To invite the participation of students, teachers were first asked to confidentially identify any children in Grade 3 or 4 with significant behavior/ emotional problems including students with extremely poor attendance. These children were excluded from further involvement in the study. In September 1994, there were approximately 134 students enrolled in Grade 3 and 4 at the school. Of these students, 21 were excluded from further involvement based on the above criteria. After this, a letter was sent out with the remaining Grade 3 and 4 students along with a consent form and history form. On the basis of this history form any children with a known history of fetal alcohol syndrome, emotional disorder, mental retardation, or neurological deficits were also eliminated from the sample.

The final selection of students was on the basis of the reading comprehension measure from the Stanford Diagnostic Test of Reading (SDRT). School staff administered the SDRT in May 1994 to all students at the school. Based on the entire distribution of reading comprehension ability for third and fourth Grade students in the school, a stratified sample of 53 children was selected for participation in the first phase of this research. That is, subjects were selected so that there were approximately equal numbers of girls and boys and so there would be representation from all reading comprehension levels.

The Sample

The initial portion of this research involved 23 boys and 30 girls (N=53) from the Grades 3 and 4 classrooms of the school. These children ranged in age from 7 years 10 months to 10 years 9 months (Mean Age= 9 years 0 months). Following the scoring of all the measures, several subjects had to be eliminated from the analysis as they had incorrectly filled out their test or had responses which otherwise spoiled the scoring. For the Canadian Test of Cognitive Skills there were 10 spoiled subtests leaving N=43 valid cases for analysis for Memory, Analogies and the Verbal subtests. An additional subject was dropped from the analysis from the Sequences and the Non-Verbal subtests due to spoiled responses. This left N=42 subjects for these subtests.

For the SDRT there was one spoiled test for the Auditory Vocabulary subtest and one for the Reading Comprehension subtest leaving N=52 subjects for analysis for each subtest. For all the remaining psychometric measures all 53 children were available for analysis. In all analyses, invalid cases were eliminated casewise so that the maximum sample size could be utilized.

Psychometric Measures

IQ Measure. All children in Grades 3 and 4 were tested at the school in October with a more traditional IQ measure, the Canadian Test of Cognitive Skills (CTCS) - Level 1 (Canadian Test Center, 1992). Following computer scoring, several subjects had to be eliminated as they had incorrectly filled out their test or had responses which otherwise spoiled the scoring. This left a total of 42 valid cases for analysis on this portion of the testing.

The CTCS is a group-administered test that has been normed based on a Canadian stratified random sample by age. The test manual reports good reliability and validity. This test was chosen primarily for ease of administration and scoring and to provide a more traditional index of intellectual performance based on Canadian norms and content. Also, the school was interested in establishing ability levels of students and this test was considered to be the most appropriate for the school's purposes. This is because the CTCS consists entirely of pictorial item content while the directions are spoken by the examiner (in this case the classroom teacher). This high degree of non-verbal content and administration by a person familiar to the students made the CTCS the more appropriate choice for the school's needs. To set up the scheduling for this portion of the testing, a letter and sign up sheet was sent to teachers. This letter can be found in Appendix A.

Subtests that yield an overall IQ score for the CTCS consists of sequences, memory, analogies, and verbal reasoning.

The *Sequences* subtest reportedly measures a child's ability to comprehend a rule or principle implicit in a sequence of figures, letters, or numbers. The student was required to analyze a visual pattern established in a row of figures and then select the answer choice that would complete the sequence.

The *Memory* subtest is an auditory-visual task that measures the child's ability to recall previously presented picture pairs. The test is given in 2 parts. The first part is a learning trial where students are presented with 20 picture pairs. The second part is given after an interval of 15 minutes where the students are required to recall the previously presented picture pairs.

The *Analogies* subtest is a visual analog task where the child is required to perceive the relationship between two pictures and then, given a third picture, choose a fourth picture that is related to the third in the same way that the first two pictures are related. This is a classic A is to B as C is to__________ design, utilizing visual information.

The *Verbal Reasoning* subtest purportedly measures the student's ability to solve verbal problems by reasoning deductively, analyzing category attributes, and discerning relationships and patterns. Some items required children to identify an essential element of an object or concept. Other items required classification according to common attributes. Another item type required children to infer relationships between separate but related sets of words. A final item type required the drawing of logical conclusions from information given in short passages of text that were read aloud to the children.

Reading Measures. Reading ability was measured using the *Stanford Diagnostic Reading Test* (SDRT) (Karlsen, Madden, & Gardner, 1984). This test is a group test that provides scores for auditory discrimination, phonetic analysis, structural analysis, as well as vocabulary and comprehension. The SDRT has several levels and for this portion of the research the Red Level and the Green Level were used. Subtests that are common to both levels include auditory discrimination, phonetic analysis, auditory vocabulary, and reading comprehension. It is these subtests that were used for analysis in this research.

There were several reasons for choosing the SDRT. The first reason was pragmatic as the school had already administered this test school-wide and the data were easily accessible. The second reason for selecting the SDRT was good psychometric properties. The test manual reports Kuder-Richardson reliabilities of .84 to .98 for the Red Level and .85 to .96 for the Green level (Harcourt Brace Jovanovich, Inc. 1984). The Red Level and Green level are considered to be equivalent forms. The correlations between the levels were: auditory vocabulary = 0.66, auditory discrimination = 0.49, phonetic analysis = 0.52, and comprehension = .74. Thus, comprehension scores are considered to be the most comparable across levels. The third reason to use the SDRT was the inclusion of reading vocabulary, phonological coding, and comprehension measures. All of these measures are of interest as dependent measures in this study. The SDRT subtests are described below:

1. *Auditory Discrimination*: The auditory discrimination test required the children to identify whether two spoken words share the same sound at the beginning, middle or end of the word.
   E.g. "Truck – Hack"   B(   ) M (   ) E (X)
2. *Phonetic Analysis*: The phonetic analysis task required the children to match words that share the same phonetic sound. For each item a key word was presented with some portion underlined. The children were then presented with three words. Their job was to find the word that had the same sound as the underlined portion of the key word.
   e.g. snake   stick paid cab.
3. *Auditory Vocabulary*: This test provides information about language competence without requiring the student to read (Harcourt Brace Jovanovich, Inc., 1984). This task is a sentence completion task with three word choices provided. All the words for this subtest were aloud to the student.
4. *Reading Comprehension*: This task involves the reading of a short story or paragraph followed by several multiple-choice questions. Comprehension is measured both in terms of literal comprehension and inferential comprehension of the text.

During the course of this study, some problematic issues came to light regarding the administration of SDRT measures. When this study was initiated, there was no reason to question the validity of administration of the SDRT. Only after the study was completed was it revealed that school staff, although well-meaning, may not have followed standardized administration instructions. In fact, the special education coordinator reported that some teachers may have read aloud items that the students would normally have been required to read themselves. In addition, some teachers apparently had done some practice testing immediately prior to the SDRT administration. These factors represent systematic errors that most likely would have led to an artificial increase in many students' scores. Unfortunately, this revelation also draws into question the validity of any inferential analysis using SDRT subtests. In particular, Reading Comprehension and Phonetic Analysis subtests could be considered the most suspect as these subtests required that the student read the words independently. At best, Reading Comprehension might be more appropriately considered a measure of listening comprehension for the students who received help. Since there is no way of knowing which students received help, or how much help, all inferential statistics with these two measures will be eliminated. The only exception will be the correlational analysis which was left in but will be interpreted with great caution.

Word Probe. In addition to the SDRT, an informal reading measure in the form of a Word Probe was administered (see Appendix B for the complete list of words used). The Word Probe was simply a list of 450 phonetically regular words presented in isolation. The child was required to read each word aloud. Three separate lists of words were presented to each child. Words were presented on 12cm x 9cm laminated cards with 5 words per card presented vertically. For example, the first five words for Level 1 were presented as follows:

bee
map
fog
bag
rob

Generally, words became longer in length the further into the list for each level. Words ranged from three-letter words to seven-letter words. The words with the longest length occurred in Level 3. Given the relatively low reading level of the sample of children for this study, a cutoff score was set as many children would have faced needless presentations of words they clearly could not decipher. A cutoff score of 5 consecutive errors was chosen arbitrarily. In addition, as soon as a child reached cutoff in any series, the remaining series of words were not administered.

This measure was chosen for two reasons. First, this measure offered a measure of individual word reading which was not available in the SDRT. Second, this measure was chosen to replicate a previous study (Das, Mishra, & Pool, 1995).

Cognitive Measures According to the PASS Theory

This portion of the assessment consisted of selected subtests from the Das, Naglieri: Cognitive Assessment System (CAS) (Riverside Publishing, 1997). The CAS was designed by Das and Naglieri (1993) to assess cognitive functioning according to the PASS model described previously. The CAS is based on over 15 years of research into the PASS model. The CAS version being employed for this study was in the process of standardization. Since the completion of this study, the final version of the CAS has been published and presented to the scientific community.

For the purposes of this study, CAS subtests included one planning (Planned Connections), one attention (Expressive Attention), two simultaneous (Figure Memory and Matrices) and two successive tasks (Word Series and Speech Rate). The full version of the CAS includes 3 planning, 3 attention, 3 simultaneous, and 4 successive tasks. The psychometric properties of the CAS include Cronbach alpha values ranging from a low of .75 to a high of .82 for the various subtests of the CAS (Das, Mishra, & Kirby, 1994).

The following descriptions will describe the subtests and indicate which component of the model it is designed to assess.

1. *Planned Connections* - Planned Connections required the subject to join, in ascending order, numbers that have been scattered on a page. The second part of the task required the subjects to join alternating letters and numbers in ascending order (e.g. 1, A, 2, B, 3, C, ...). This task is very similar to Trail Making (Lezak, 1976) and is designed to measure the planning component of the PASS model.

2. *Expressive Attention* - This task is very similar to the Stroop task (Stroop, 1935). For younger children, this task involved identifying whether an animal is big or small. For example, if a child saw a picture of a whale they would say "large" and if they saw a mouse they would say "small". First, various types of animals were presented in one size on the page. Then the size on the page was alternated between large and small irrespective of how large the animal is in reality. For example, the child might see a small-sized picture of a whale, but still need to say "large". This second task served as an interference task. For older children, Expressive Attention included a task where children read the words red, green, yellow, and blue on three separate pages. Children were required to read the words as fast as possible. On a second card was a palette of the colors red, green, yellow, and blue. The child's task for this card was to name the colors as rapidly as possible. On the last card the words red, green, yellow, and blue were presented in various colors of ink. This interference task required the child to rapidly name the color of ink that the word was printed in. Both of these tasks are considered to be primarily measures of attention.

3. *Matrices* - In Matrices, the subject was required to complete a visual matrix of abstract objects. Matrices were presented in a 2 X 2 or 3 X 3 format. Each component of the matrix must be interrelated to the others. This requirement of interrelatedness is what makes this task a measure of simultaneous processing.

4. *Figure Memory* - This required the child to copy a geometric design from a model by memory. More specifically, the child was presented with a geometric figure and then after five

seconds was presented with a more complex figure that had the original figure embedded within it. The child's task was to trace the outline of the figure within the more complex figure. It was required that the design be incorporated into memory as a whole so that all of the parts are interrelated. This requirement is what made this task a measure of simultaneous processing.

5. *Word Series* - This task required subjects to repeat a series of single syllable words, ranging in length from two to nine words. Essentially this task is similar in nature to the more common Digit Span test only using words and without the backwards component. The linearity of this task qualifies it as a measure of successive processing.

6. *Speech Rate* - This task required the child to repeat three different one-syllable words 10 times in rapid succession. This is a timed task that assesses articulation ability as well as rapid naming ability. This task is considered to be predominantly a successive processing measure.

Rationale for the choice of the CAS Subtests

The subtests chosen for this study were selected to give a measure of cognitive functioning along each of the components of the PASS model. In addition, the particular subtests were chosen to match past research (Carlson & Das 1992). The particular subtests used here have been shown to have a significant relationship with reading in other populations. For example, rapid naming and articulation tasks have been shown to be related to reading achievement, word identification skills and reading speed and accuracy (Blachman, 1984; Cornwall, 1992; Felton & Brown, 1990). Speech Rate and Expressive Attention subtests from the CAS both have rapid naming and articulation components.

For the purposes of this research the successive tasks chosen, i.e., Word Series, and Speech Rate, have both shown strong relationships with reading in other research contexts. Words Series, which is essentially a verbal version of the more common Digit Span subtest from the Wechsler Intelligence Scales, could be considered a verbal memory task. Wagner et al. (1990) have suggested that a combination of reliable measures of word span and/or articulation rate may provide a good index of phonological coding processes in young children.

The choice to include only a single measure of planning and attention was made for two reasons. The first reason was simply pragmatics. The students were already being required to undergo considerable individual and group testing and every effort to limit the time of testing was essential to limit the amount of missed classroom time, and to ensure the student's attention during testing. Second, the constructs of planning and attention, while clearly important to reading, have consistently shown a weaker relationship than successive and simultaneous processing tasks. For this reason, only a single measure of each construct was included to get a benchmark of performance on these important constructs.

Procedure for Psychometric Measures

The SDRT had been administered and scored by school personnel in May 1994. Following sample selection, school personnel within each classroom also administered the CTCS during the last two weeks in September 1994. The CTCS results were submitted to a company where it was computer scored. All the remaining psychometric measures, including the Word Probe and the CAS, were administered individually within the School during a single testing session with each student. Each testing session took approximately one hour and was conducted in a private room within the school. CAS and Word Probe testing was completed between October 7, 1994 and October 20, 1994. Testing was completed either by the author of this dissertation or by two graduate students from the University of Alberta. All examiners had completed a course in individual psychological assessment and were given specific training in the administration of the CAS. Every examiner had opportunity to give a practice administration of the CAS prior to giving it to the subjects in this research.

The CAS was administered according to instructions within the administration manual in the order the manual dictates. That is, for every child the subtests were administered in the following order: Planned Connections, Matrices, Figure Memory, Expressive Attention, Word Series, and Successive Speech Rate.

Statistical Procedures

For Hypothesis 1 a) and 1 b), Pearson Product Moment correlations were used to determine the significance of relationships between the various measures of the CAS and the SDRT. This statistic was chosen due to the continuous nature of the data. As the variability in scores within some of the subtests was quite high at times (i.e. Word Probe) Spearman Rank-Order correlations were run in addition to the Pearson correlations for a more conservative estimate of relationship.

Hypotheses 2 and 4 were intended to test different effects between subgroups of varying vocabulary ability and individual word reading ability . The analysis with Word Probe consisted of t-test designs comparing readers of varying reading ability (low and high individual word reading) across the six CAS subtests chosen for this study. As there were only six separate analyses planned, and there was some reason to suspect that poorer readers would mainly be weak in terms of successive skills, univariate tests were chosen over the MANOVA. The analysis with Auditory Vocabulary consisted of univariate ANOVAs instead of t-tests as there were three groups. Tukey's Honestly Significant Difference (HSD) tests were used as post hoc tests to determine differences between groups.

Originally, it was intended to include some analyses with a reading comprehension measure. However, given the previously stated problems with the administration of the Reading Comprehension subtest the validity of the analyses was suspect and a decision was made to omit the analysis.

Hypothesis 3 and 5 was also originally intended to include some measure of reading comprehension. Once again, the problems in SDRT administration precluded the use of those subtests from further analysis. Rather, a discriminant function analysis was performed to determine whether CAS subtests could successfully predict of group membership. For hypothesis three groupings were based on Auditory Vocabulary results (i.e., very poor, poor and average) while for hypothesis five grouping were based on Word Probe (i.e., low or high).

During the course of analysis, a number of questions arose that required additional analyses. However, as these analyses did not specifically address the main hypotheses, they are presented in Appendix C. For example, a correlational analysis was performed between the CAS and the CTCS. This was done mainly to explore the differential validity of the CAS.

CHAPTER 4

Results

Descriptive Measures - Canadian Test of Cognitive Skills

Table 4.1 presents descriptive statistics for the entire group by Grade in terms of their Canadian Test of Cognitive Skills (CTCS) results. This examination was necessary because normative comparisons were not possible across Grade levels. The individual subtests from the CTCS are presented in terms of scaled scores as well as national percentiles according to Grade level. Scaled scores are units of a single equal-interval scale that is applied across all levels of the CTCS.

The first major finding from this table is that the native children performed in the low average range as a group with a considerable number of children scoring below an IQ of 75. An IQ below 75 is generally considered to be a cutoff for mental deficiency.

Table 4.1

Descriptive Statistics For Canadian Test Of Cognitive Skills According To Grade Level

Variable	Mean	Std Dev	MIN	MAX	Percentiles
		Grade 3 Results (n=16)			
Memory	481.47	62.53	397	622	40
Sequences	294.25	50.32	228	397	7
Analogies	368.88	39.57	300	444	12
Non-Verbal	331.69	38.92	276	392	7
Verbal Reasoning	292.00	66.03	185	443	18
*CSI	75.69	10.06	63	95	7
		Grade 4 Results (n=26)			
Memory	504.46	75.11	375	622	46
Sequences	347.73	84.20	228	513	12
Analogies	395.15	71.46	292	560	14
Non-Verbal	371.69	71.02	264	520	11
Verbal Reasoning	328.04	81.33	196	466	15
*CSI	80.50	10.26	58	112	11

*note: The CTCS subtests scores are scaled scores while the CSI is a deviation IQ (i.e., mean=100, Sdev=16)

In actual fact, closer examination of the results revealed that 22 students or 52.4% of those tested scored below 75. Possible reasons for these low IQ scores will be discussed in the next chapter.

As can be seen in Table 4.1, 42 out of a possible 53 valid administrations were available to yield an overall Cognitive Score Index (CSI). This was due to several spoiled test forms and absences the day the testing took place. The CSI for both groups was low average with the overall CSI at 78.67 (range: 58-112; Standard Deviation=14.3). Examining Grade 3 and 4 students separately, it can be seen that both groups performed within the average range in terms of their non-verbal memory score. However, both groups were below average to borderline on all remaining subtests including sequences, analogies, and verbal skills. Overall, non-verbal skills were low average.

Descriptive statistics for the Stanford Diagnostic Reading Test (SDRT) according to Grade level are reported in Table 4.2. As was the case for the CTCS, results on the SDRT were generally deflated relative to the standardization group. The Grade 3 children generally scored in the below average range in terms of Auditory Vocabulary, Phonetic Analysis and Reading Comprehension. Conversely, Grade 3 students were within the average range in terms of Auditory Discrimination scores. Similarly, Grade 4 students were in the low average range on all scores including Auditory Discrimination. However, Auditory Discrimination was the highest score relative to the other subtests. As mentioned previously, Auditory Discrimination involves the phonetic analysis of words and required the children to identify whether two words share the same sound at the beginning, middle or end of the word. To more accurately show the extent to which readers had significant reading deficits, a cutoff score of the 5th percentile was used so that subjects with scores below this cutoff were added to the tally. It was found that 7 subjects (13.2%) had Auditory Discrimination scores below the 5th percentile. Similarly, 15 subjects (28.8%) had Auditory Vocabulary scores below the 5th percentile while 11 subjects (20.8%) were below on Phonetic Analysis and 17 subjects (32.7%) were below the 5th percentile on Reading Comprehension.

Because of the large numbers of children who were scoring well-below average on all of the SDRT measures, it was felt necessary to further identify those students who tested with low IQ together with low reading comprehension ability (poor readers) versus those with average to high IQ and low reading comprehension ability (reading disabled). It was found that 7 students (16.7% of total sample) showed both low IQ and Reading Comprehension ability below the fifth percentile. Conversely, 10 students (23.8% of total sample) had an IQ score above 75 while their

Reading Comprehension ability was below the fifth percentile. These latter subjects would fit into the more traditional category of Learning Disabled according to the discrepancy definition.

Table 4.2

Descriptive Statistics For Stanford Diagnostic Reading Test According To Grade Level

Variable	Mean	Std Dev	MIN	MAX	Percentiles
		Grade 3 Results (n=24)			
Auditory Vocabulary [a]	507.22	59.40	401	645	13
Auditory Discrimination	566.04	72.61	454	678	35
Phonetic Analysis	521.00	90.98	331	646	15
Reading Comprehension	481.83	76.85	389	690	9
		Grade 4 Results (n=29)			
Auditory Vocabulary	515.55	33.41	445	603	7
Auditory Discrimination	548.90	90.37	336	716	21
Phonetic Analysis	523.10	39.78	456	612	13
Reading Comprehension [b]	527.46	62.43	402	624	13

[a] Sample size for this subtest was 23 due to one spoiled response. [b] Sample size for this subtest was 28 due to one spoiled response.

Functionally speaking, the vast majority of students in this population were scoring well below Grade level. To further illustrate the extent and the degree of the deficits in a more functional way, the scores were broken down into Grade equivalents. The result of this transformation revealed that 20% (N=10) of the sample were functioning at or below a Kindergarten level, 42% (N=21) of the total sample were functioning between a Grade 1.0 and 1.9 level, 24% (N=12) were functioning between a Grade 2.0 to 2.9, 8% (N=4) of the total sample functioning between a Grade 3.0 and 3.9 level, and only 6% (N=3) were functioning better than a Grade 4.0 level.

Informal Word Probe and CAS Results

To provide an additional measure of individual word reading, an informal word probe was utilized (See Appendix A for a complete list of words used). As reported in Chapter 3, a ceiling was established of 5 consecutive errors. After reaching this cutoff, no further words were presented on any of the remaining lists. The result was that some children were only presented words from list 1, some list1 and list2 and others all three lists. This had the effect of creating three clusters of scores, or a tri-modal distribution of scores, and also created quite large standard deviations. Results from the Word Probe are presented in Table 4.3 along with raw data from the CAS subtests. From Table 4.3 we can see that the standard deviation for Word Probe was almost equal to the mean which represents considerable variation.

Table 4.3

Word Probe And Cognitive Assessment System Raw Scores (N=53)

Variables	Mean	Std Dev	MIN	MAX
Word Probe	183.70	165.31	0	446
Speech Rate [a]	133.45	39.95	84	317
Word Series	9.81	3.00	5	18
Figure Memory	9.28	2.54	4	17
Matrices	14.58	3.76	9	25
Planned Connections [a]	315.62	85.18	164	509
Expressive Attention [a]	161.81	38.70	97	256

[a] Scores are total time in seconds. All remaining scores are raw scores.

In order to derive greater meaning from these results the raw data were subjected to normative comparison. In order to accomplish this, data were recoded to match scores used in the initial standardization sample of the CAS. The initial standardization sample consisted of a stratified sample of 954 girls and 963 boys between the ages of 4.5 to 19 years. This allowed for group comparisons of the present sample of native children with their respective age peers. Data were transformed into individual deviation scores relative to the standardization sample using Formula 4.1. The only change to this formula occurred for timed subtests. For timed subtests, Formula 4.2 was used:

Formula 4.1: $(\text{Raw}-\Omega 1)/\text{SD1}$

Formula 4.2: $(\Omega 1-\text{Raw})/\text{SD1}$

Raw = Raw Score Native sample

$\Omega 1$= Mean Raw Score Standardization Sample

SD1 = Standard deviation for Standardization Sample.

For each of the above formulas the Mean Raw Score Standardization Sample was taken from the corresponding age group to the native sample. This calculation of an average deviation is essentially equivalent to producing a z-score where positive values always represented better performance than the norm while negative values represented poorer performance relative to age norms. Thus, the standardization sample would have a mean of 0 and a standard deviation of 1.0. If we assume a normal distribution then deviation scores can be converted into standard scores (i.e., Mean=100; Standard Deviation=15). For example, if a native student achieves a deviation score of +1.00 for Matrices, this would indicate that this individual scored one standard deviation above the mean compared to the standardized group. This translates into a standard score of 115, which represents a significantly above average score relative to the standardization sample. The result of this statistical manipulation is presented in Table 4.4.

From Table 4.4 we can see that the native population, as a group, consistently scored below national age norms on all CAS subtests. The weakest performance was observed on the Speech Rate subtest, where the native sample scored nearly a full standard deviation below age norms. The native samples' best performance was on the Figure Memory subtest, a Simultaneous Processing task.

Table 4.4

CAS Deviation Scores And Standard Score Equivalent Based On National Standardization Norms (N=53)

Variable Name	Deviation Score	Standard Score Equivalent [a]
Speech Rate	-.86	87.1
Word Series	-.45	93.2
Figure Memory	-.37	94.4
Matrices	-.43	93.2
Planned Connections	-.50	92.5
Expressive Attention	-.48	92.8

Note: Deviation scores are the average of standard deviations from age norms. Negative scores represent poorer performance among the native group. [a] Mean=100 Standard Deviation=15.

Correlational Analyses

CAS versus SDRT

Pearson product moment correlations were used to explore the relationships between the various cognitive tasks on the CAS and reading ability as measured by the SDRT among the native children. The results of this analysis are presented in Table 4.5.

There are several significant findings from Table 4.5. First, we can see that none of the CAS simultaneous tasks correlated significantly with any of the reading measures. In contrast, both of the successive tasks had significant correlations with several of the reading measures. That is, Speech rate correlated with auditory vocabulary, phonetic analysis, and reading comprehension and the Word Probe, while Word Series correlated with Auditory Discrimination and Auditory Vocabulary. Examination of outliers revealed a strong outlier for a single subject on both Speech Rate and Phonetic Analysis. The effect of eliminating this subject from the analysis was that the significant correlation between Speech Rate and Phonetic Analysis dropped to non significant levels (r=-0.11). All of the remaining correlations dropped slightly but maintained their level of significance.

Table 4.5

Correlations Between Reading Scores And CAS Subtests (N=53)

Subtests	AD	AVoc	PhAn	R Comp	Word Probe
Successive Tasks					
Speech Rate [a]	-0.20	-0.42*	-0.31*	-0.37*	-.39*
Word Series	0.48*	0.34*	0.21	0.21	.21
Simultaneous Tasks					
Figure Memory	0.11	0.00	-0.05	-0.06	.04
Matrices	0.00	-0.05	-0.08	0.04	.22
Planning					
Planned Connections [a]	0.01	-0.34*	-0.08	-0.15	-.30*
Attention					
Expressive Attention [a]	0.11	-0.23	-0.26	-0.44*	-.32*

* p<=.02, p based on two-tailed probability

[a] These scores are time in seconds where larger scores represent weakest performance.

Note: AD= Auditory Discrimination, Avoc= Auditory Vocabulary, PhAn=Phonetic Analysis, R Comp=Reading Comprehension

A second point of interest was the fact that both Speech Rate and Expressive Attention, which both have articulation components, were significantly correlated with the reading comprehension and the Word Probe. Third, it should be noted that the planning task that was included only had significant correlations with the Vocabulary subtest.

To more closely examine the inter-relationships among CAS subtests, a correlational analysis was performed. As an outlier on Speech Rate had an influence on some of these relationships the results presented in Table 4.6 do not include the outlier. One significant finding from Table 4.6 was the fact that all of the timed subtests tended to be significantly inter-correlated (i.e., Speech Rate, Planned Connections, and Expressive Attention). A second significant correlation occurred between Figure Memory and Matrices, which are both purported measures of simultaneous processing.

Table 4.6

Inter-Correlations Between CAS Subtests (N=52)

CAS Subtests	1	2	3	4	5	6
1.Speech Rate	1.00					
2. Word Series	-0.21	1.00				
3. Figure Memory	0.13	0.08	1.00			
4. Matrices	-0.09	0.19	0.53**	1.00		
5.Planned Connections	0.[illegible]3	-0.05	0.17	0.03	1.00	
6. Expressive Attention	0.28*	0.02	0.02	-0.23	0.38**	1.00

* p<.05; ** p<.01, two-tailed

The strong inter-relationship between the reading measures is shown in Table 4.7. In particular, there was a very strong relationship between Word Probe and Reading Comprehension for this sample. Examination of scatterplots revealed that Phonetic Analysis had several low outliers. However, the elimination of these outliers had very little effect on the correlations. That is, without the outliers, correlations retained their level of significance.

Table 4.7

Inter-Correlations Between Reading Measures

CAS Subtests	1	2	3	4	5
1. Auditory Vocabulary	1.00				
2. Auditory Discrimination	.49**	1.00			
3. Phonetic Analysis	.46**	.36**	1.00		
4. Reading Comprehension	.45**	.47**	.65**	1.00	
5. Word Probe	.31*	.25	.36**	.70**	1.00

*p<.05; ** p<.01, two-tailed

Inferential Statistics

Auditory Vocabulary Analysis

In order to determine how cognitive patterns differed according to reading ability with this population a separate analysis was performed which divided the sample into three groups based on Auditory Vocabulary results. Groups included Very Poor (VP), Poor (P), and Average (AVG) performers on Auditory Vocabulary. Groups were separated in the following manner: VP readers performed at or below the 5th percentile (N=15), P readers performed between the 5th and 30th percentiles (N=25) while AVG readers were above the 30th percentiles (N=12).

Group Differences. Descriptive statistics for the CAS by Group are presented in Table 4.8. From this table we can see that there were clearly differences between VP and P readers. However, an unusual result occurred for the AVG readers in that their performance on timed tasks was actually worse than P readers but better than VP readers. Several univariate ANOVAs with CAS subtests as the dependent variables were performed on these results to determine whether there was a statistically significant difference between groups.

Univariate F values for each of the CAS variables by Group are presented in Table 4.9. From this table we can see that only Speech Rate and Word Series showed significant differences between groups.

Table 4.8

Very Poor, Poor, And Average Readers On Auditory Vocabulary And Their Respective CAS Results.

	Very-Poor (N=15)		Poor (N=25)		Average (N=12)	
CAS Subtest	M	SD	M	SD	M	SD
Word Series	9.0	2.10	9.4	2.71	11.67	3.98
Speech Rate	157.07	58.58	121.24	25.24	130.25	25.81
Figure Memory	9.27	1.87	8.72	2.48	10.58	3.15
Matrices	14.13	3.44	15.00	4.01	14.67	3.77
Expressive Attention	175.20	53.75	151.28	33.40	164.75	19.89
Planned Connections	348.73	83.33	289.84	66.22	323.00	111.84
Age (months)	107.53	8.57	111.24	8.76	103.75	9.07

Table 4.9

Univariate F Tests (2,49) For Vocabulary Group (VP, P, AVG) For Each CAS Variable

Variable	F Value	P value	Power
Word Series	3.29	.046	.60
Speech Rate	4.23	.020	.72
Figure Memory	2.27	.115	.44
Matrices	0.24	.785	.09
Expressive Attention	1.90	.160	.38
Planned Connections	2.42	.099	.47

Tukey's Honestly Significant Difference (HSD) post hoc analysis revealed a significant difference for Word Series between the VP and AVG groups, in favor of the latter. For Speech Rate, a significant difference occurred between the VP and P groups, with better performance in the P group.

To supplement the above findings, a univariate F test was also run for age between the three Vocabulary groups. This result of this analysis was F(2,49)=3.07, p=.056. Tukey's HSD for this analysis s that the P group were significantly older than the AVG group.

Discriminant Function Analysis. A discriminant analysis was performed in order to determine whether CAS variables could successfully predict group membership in terms of VP, P and AVG Auditory Vocabulary performers. The purpose of this analysis was to determine how much better than chance group membership could be predicted. Following a canonical discriminant analysis where all CAS variables were entered together, the overall predictability was 63.5% for Auditory Vocabulary group membership which was significant (p=.05). The actual classification results are presented in Table 4.10. It was found that this level of predictability was possible when using only the successive and simultaneous tasks (i.e., Speech Rate, Word Series, Figure Memory, Matrices). Re-running the discriminant analysis with just these variables resulted in an overall predictability rate of 61.54% (p=.06).

Table 4.10

Classification Results of Discriminant Analysis Using CAS Variables (N=52) to Predict Auditory Vocabulary Group Membership

	Predicted Group		
Actual Group	Group 1 VP	Group 2 P	Group 3 AVG
Group 1 VP (N=17)	5	9	1
	33.3%	60.0%	6.7%
Group 2 P (N=22)	1	20	4
	4.0%	80.0%	16.0%
Group 3 (N=13)	2	2	8
	16.7%	16.7%	66.7%

Percent of "grouped" cases correctly classified = 63.5%

While the discriminant function predicted group membership better than chance, there were still considerable false positives using only CAS variables. As it had already been determined that the groups differed significantly according to age, an additional analysis was run including age as a variable. This addition alone led to only marginal increase in overall predictability. It seemed possible that these groups might also differ in terms of overall intellectual level. Therefore the CSI from the CTCS was also included in the analysis. As the CSI only had 42 valid cases for analysis the final degrees of freedom for the discriminant function were (2, 39).

Table 4.11 presents the classification results of this discriminant analysis. The Chi-Square for the canonical discriminant functions were as follows: (After Function 0, Chi-square=39.2, p=.0003; after Function 1, Chi-square=14.1, p=.03). The overall predictability increases dramatically to 80.95% correctly classified when age and CSI are included as variables.

Clearly the loss of 13 subjects from the analysis may have had an effect on the data, however the result seems robust despite the small sample size.

Table 4.11

Classification Results of Discriminant Analysis Using CAS, Age and CSI as Variables (N=39) to Predict Auditory Vocabulary Group Membership

	Predicted Group		
Actual Group	Group 1 VP	Group 2 P	Group 3 AVG
Group 1 VP (N=12)	10	2	0
	83.3%	16.7%	0%
Group 2 P (N=19)	1	16	2
	5.3%	84.2%	10.5%
Group 3 (N=11)	1	2	8
	9.1%	18.2%	72.2%

Percent of "grouped" cases correctly classified = 80.95%

Word Probe Analysis

Auditory Vocabulary was not a reading measure per se, a separate analysis was run with groupings based on Word Probe. However, groupings for Word Probe included only a high and low group. This was because visual inspection of the distribution of scores for Word Probe demonstrated a tri-modal distribution with wide gaps between groups. This tri-modal distribution is aptly demonstrated in Figure 4.1 which shows the histogram for Word Probe results. Given this distribution of scores, a cutoff of 200 was used to split the sample into a low and high group. This yielded a Low Group of N=33 students and a High Group of N=19 students.

Group Differences. Descriptive statistics for Low and High Groups and their respective CAS scores are presented in Table 4.12. From this table we can see that there was a general trend for subjects who were high on Word Probe to also have better performance on CAS subtests.

Figure 4.1 Histogram of Word Probe Scores

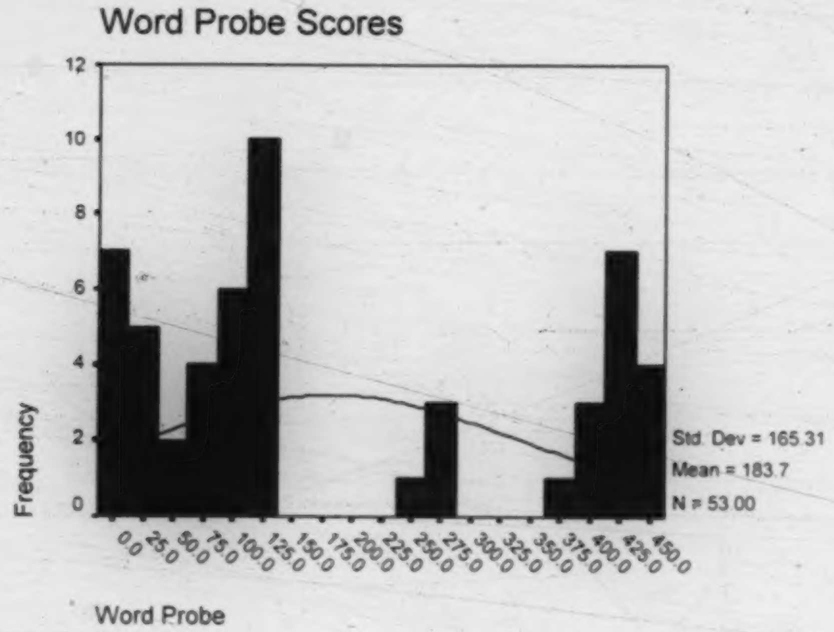


Table 4.12

Low and High Readers on Word Probe and Their Respective CAS Results.

	Low (N=33)		High (N=19)	
CAS Subtest	M	SD	M	SD
Word Series	9.5	2.5	10.5	3.7
Speech Rate	139.1	30.9	114.1	24.2
Figure Memory	9.3	2.6	9.3	2.5
Matrices	14.2	3.6	15.5	3.9
Expressive Attention	168.5	41.2	148.8	31.7
Planned Connections	330.9	86.9	283.8	74.1
Age (months)	105.9	9.3	113.2	6.6

Independent samples t-tests comparing High and Low groups were run for the six CAS subtests. T-test results are presented in Table 4.13. From this table it can be seen that there were significant differences between groups for Planned Connections and Speech Rate, and a near significant difference for Expressive Attention. In every case, the Low Word Probe group had poorer performance than the High Group. Also of note was that there was a significant age effect. That is, the High Group was significantly older than the Low Group.

Table 4.13

Independent Samples T-tests (1,50) Comparing Low and High Word Probe Groups For Each CAS Variable and Age

Variable	t	p
Word Series[a]	-1.06	.30
Speech Rate	3.03	.004
Figure Memory	-.02	.99
Matrices	-1.28	.21
Expressive Attention	1.80	.079
Planned Connections	1.98	.05
Age (months)	-3.00	.004

[a] Equal Variances not assumed

Discriminant Function Analysis with Word Probe. Hypothesis five was that Group membership (i.e., low or high individual word reading) will be successfully predicted, by greater than chance, based on individual's performance on CAS subtests. A discriminant function analysis was used to test this hypothesis. The single outlier for Speech Rate was eliminated prior to this analysis. This left a total sample size of 53 for this analysis. An examination of scatterplots to check for normality, linearity and homoscedasticity revealed that while there was a multi-modal distribution of Word Probe results. However, discriminant function analysis is robust to violations of assumptions of normality (Tabachnick & Fidell, 1989).

All CAS subtests were entered together to predict whether a student was low or high on their Word Probe results. The result of this discriminant analysis was non-significant. However, because correlational analyses revealed several significant correlations between independent variables, as well as some demographic variables (i.e., age and CSI), a step-wise discriminant analysis was also run.

The first step-wise discriminant analysis using only CAS subtests as independent variables showed that only Speech Rate was entered into the equation. Speech Rate alone was able to significantly discriminate between low and high Word Probe readers (F(1,50)=9.17, p=.004). The overall function defined by Speech Rate was successful in predicting group membership (i.e., low or high Word Probe Groups) such that 67.3% of original grouped cases were correctly classified. This analysis was run a second time in order to rule out the influence of age as a variable. When this was done, age was entered into the function at step two and was significant (F(2,49)=7.23, p=.002). The overall function defined by Speech Rate and Age was successful in predicting group membership (i.e., low or high Word Probe Groups) such that prediction rose to 76.9% of original grouped cases correctly classified. This result was significant (Chi Square=12.67, p=.002). The classification results are presented in Table 4.14.

Table 4.14.

Classification Results of Step-Wise Discriminant Function Analysis to Predict Word Probe Groups.

	Predicted Group	
Actual Group	Group 1 "Low"	Group 2 " High"
Group 1 Low (N=33)	24	9
	72.7%	27.3%
Group 2 High (N=19)	3	16
	15.8%	84.2%

Percent of "grouped" cases correctly classified = 76.9%

CHAPTER 5

Discussion

Descriptive Results

The first major finding was that the native children, as a group, had low cognitive scores on the CTCS. There are several possible explanations for this result. The first possibility relates to the traditional cultural bias present in IQ tests. Native peoples have been one of the most vocal groups to speak out against the use of standardized testing of their children. For example, the Bureau of Indian Affairs Task Force in 1972 recommended that standardized tests developed on population norms should "be phased out in an orderly but firm manner." (from Guilmet, 1983). Guilmet (1983), who studied the use of standardized tests with a group of Navajo children, expresses this sentiment very clearly and forcefully. Guilmet stated,

> Standardized tests are especially harmful to Native Americans because norm-reference tests unfairly discriminate against minority groups. They lead to harmful and inappropriate stereotyping, and are psychologically harmful as traumatic experiences to the student. Standardized tests also create artificial and unnecessary barriers among students by creating a sense of competition through their ranking and comparing procedures. They become instruments of forced acculturation by their imposition of test-culture values (p. 15-16).

While the above statement is an over-statement, and is provocative in equating IQ tests with trauma to the student, it may reflect a common sentiment among native people. Being heavily language-based and being biased towards upper-middle class white children, the CTCS may not be a fair representation of true intelligence for this cultural group.

When examining individually administered IQ tests such as the Wechsler or Stanford-Binet scales, we know that native Americans tend to score an average of 6 IQ points below norms (Sattler, 1990). However, on the CTCS the present sample scored considerably lower, and in fact was more than a full standard deviation below age norms. It seems that the traditional IQ test bias argument cannot fully explain these low IQ scores.

One possible explanation for the low IQ test scores in the present sample of native children is that they are genuinely lower in ability than the normative group. This explanation seems unlikely, as the results for the native group on the CAS were average to low average when compared to a large randomly selected standardisation group of similar age. At least, one would not expect scores that suggest mild mental deficiency on the CTCS if students are scoring closer to average on the Matrices subtest of the CAS, which has often been used as a measure of non-verbal IQ (Kirby, et al., 1996; Naglieri, 1985).

The most likely reason for low IQ scores in this sample is that the CTCS is a group-administered test and this particular sample of children had virtually no background experience with this sort of examination. Thus, a lack of test-wiseness and possibly poor motivation may have contributed to the low scores on the test. Certainly, the students were observed to help each other and had difficulty staying on task and attending to directions. These behaviours had to be closely monitored as they persisted in behaving this way despite teacher directives.

Another finding from the CTCS was lower non-verbal skills as compared to verbal skills. This result is in contrast to the many studies that suggest that natives tend to have better-developed non-verbal or visual skills compared to verbal skills (More 1989; Senior, 1993; Swisher & Deynyle, 1989). This result may be an artifact of test order as the Memory test was the first one administered. It is possible that the students were attending better early in the testing and that their performance became more variable as the testing progressed.

Low SDRT Scores

SDRT reading scores ranged from average scores for Grade 3's in Auditory Discrimination (35th percentile), low average scores in Auditory Vocabulary, Phonetic Analysis, and Reading Comprehension (9th to 21st percentiles) and borderline scores for Auditory Vocabulary in the Grade 4 group (7th percentile). More practically speaking, 62% of the entire sample was functioning at or below a Grade 1.9 level in terms of Reading Comprehension. Since these students were placed in Grades 3 and 4, this represents a delay of two or more Grade levels for many students. While some degree of lower scores may have been expected based on past research, the severity of the reading deficits was surprising. This result is even more surprising given that there appears to have been a systematic bias in test administration that likely led to inflated scores.

Once again there are many possible explanations for this result. Most of the reasons for this result mirror the explanation for the extremely deflated IQ scores. That is, these students were not very test-wise and with a group-administered test it is difficult to ensure proper attention, concentration, background knowledge and/or motivation. Second, the SDRT may have some biased test content that contributed to lower scores. However, in examining the materials and test items there did not appear to be any clearly biased items. Clearly, this would require further examination at the item level in order to determine any systematic biases.

CAS Descriptive Results

In terms of the CAS results, there were several key findings to discuss. First, the deviation scores clearly showed that the native group tended to perform below a standardization sample on all CAS subtests. For the most part, the native children scored between .37 and .86 standard deviations below the normative group. If we assume that the scores on the CAS tests were normally distributed for the standardisation sample and compare the native group's performance on CAS to more traditional IQ scores (i.e., mean=100, SD=15), the result is that the native group scored, on average, between 5.55 (Figure Memory) and 12.9 (Speech Rate) IQ points below the norm. These results seem more on par with traditional individual IQ results for native samples who generally score an average of 6 IQ points below standardization norms (Sattler, 1990).

Another CAS result that was of interest was the fact that the native group had their worst performance on the Speech Rate subtest. In contrast, they had their best performance on the simultaneous tasks of Figure Memory and Matrices. This result is directly comparable to Krywaniuk's 1974 study with the same population. Krywaniuk (1974) found that when comparing a low achieving sample from an urban setting to a low achieving sample from the same native reservation as the present sample, that the native sample tended to be similar to the urban setting sample in terms of non-verbal subtests and simultaneous tasks. However, the native sample scored significantly lower on verbal and successive tasks. Similarly, the present native sample showed significant delays in successive processing relative to a North American normative group.

There are several possible explanations for these results. First, native children may prefer a patterned symbol or simultaneous information processing approach to learning. Thus, they may be inappropriately utilizing this approach to tasks that require a more successive approach. A second possibility is that natives may indeed prefer a successive processing approach but are just weaker in applying successive strategies. Because past research has shown that natives are relatively better in terms of applying simultaneous processing strategies, the first option is more likely. However, this is a matter to be decided by future research.

CAS and SDRT Correlational Results

The first hypothesis for this portion of the dissertation stated,

> There will be a significant relationship between various subtests of the Cognitive Assessment System and reading measures. There are two more specific sub-hypotheses that can be derived from this general hypothesis.

a. There will be a significant relationship between the two subtests that involve phonetic analysis skills on the Stanford Diagnostic Reading Test (SDRT) (i.e., Phonetic Analysis or Auditory Discrimination) and the two successive tasks on the Cognitive Assessment System (CAS) (i.e., Word Series or Speech Rate).

b. There will be a significant relationship between the Reading Comprehension subtest from the SDRT and the simultaneous tasks of Figure Memory and Matrices of the CAS.

In fact, it was found that there were significant correlations mainly between successive processing tasks of the CAS and reading measures. More specifically, Speech Rate was significantly negatively correlated with the SDRT subtests of Auditory Vocabulary, and Reading Comprehension as well as the informal Word Probe. Word Series, on the other hand, correlated significantly and positively with Auditory Discrimination and Auditory Vocabulary. With the removal of the outlier, the significant finding between Speech Rate and Phonetic Analysis was no longer significant. The present findings could not strongly confirm that a significant relationship exists between phonetic analysis tasks and successive processing tasks. However, the problems inherent in the administration of SDRT subtests makes any conclusions regarding this matter tentative. Therefore hypothesis 1 a) is tentatively rejected.

Finding a significant relationship between Speech Rate and the two comprehension tasks of the SDRT (i.e., Auditory Vocabulary and Reading Comprehension) was somewhat unexpected. Speech Rate has an articulation component and is successive in nature. From the available research we know that articulation tasks, such as Speech Rate, tend to be highly correlated with individual word and pseudoword reading ability (Das, Mensink & Mishra, 1990; Das, Mok, & Mishra, 1994 ; Das & Sui, 1989). More typically, reading comprehension tasks have been correlated with simultaneous measures (Das et al., 1979; Das et al., 1996; Leong, Cheng, & Das, 1985; Mahapatra, 1990; Parilla & Kirby, 1998). Since the present sample of children were weak in individual word reading, vocabulary and in phonological coding tasks, which are requisite skills, it would be expected that they would also be weak in reading comprehension. In fact, a strong and statistically significant relationship was found between individual word reading (i.e., Word Probe) and the Reading Comprehension subtest for this sample. This implies there is some relationship between these measures. However, the problems in administration draw into question the validity of Reading Comprehension. Thus, any conclusions regarding the relationship between a rapid articulation task and Reading Comprehension remains tentative and could possibly be spurious.

There was a strong relationship found between both successive measures and Auditory Vocabulary. For Auditory Vocabulary, the present group of native readers performed more like beginning readers. That is, their ability to attend to, remember and understand individual words was poor. Words Series required the students to repeat a series of unrelated words in progressively longer strings. The sequential requirement of the task makes Word Series a successive task. However, auditory attention span, word knowledge, and short-term memory skills are also required for Word Series. Since Auditory vocabulary had each of the words read aloud to the student it seems most likely that auditory attention span and short term memory are the common elements between Word Series and Auditory Vocabulary. We already have ample evidence that good and poor readers can be distinguished based on working memory tasks (Baddeley, 1986; Baddeley, 1992; Byrne & Shea, 1979; Carr, et al., 1990; Cornwall, 1992; Siegel, 1992; Watson & Willows, 1995). However, overall proficiency in English language skills may also account for this relationship. Future studies would be needed to resolve the nature of this relationship.

Another finding of interest was that the Phonetic Analysis subtest of the SDRT was not significantly correlated with any of the CAS subtests. This result is in contrast to Little et al. (1993) who found that a factor defined by planning and attention tasks accounted for a significant portion of variance in reading achievement (83%) (from the reading subscales of the Stanford Achievement Test) and word attack and word identification skills (65%). There are several reasons for the lack of findings in the present study. The most primary reason has to do with the overall problematic nature of the administration of this subtest.

If we assume for the sake of argument that Phonetic Analysis is a reliable measure of the construct, the lack of a significant relationship with successive measures may be due to the choice of CAS subtests. Little et al. (1993) utilized Selective Attention in addition to the measures used in the present study. Second, the sample sizes for the present sample were considerably smaller than those used in the Little study (N=135 for Little and N=52 for the present study) reducing the power of the statistical test to detect a difference. Third, there were extremely low scores on the Phonetic Analysis task for the present sample of native students. Such deflated scores would have the effect of restricting the range and keeping correlation results low. Lastly the Phonetic Analysis subtest is not necessarily directly comparable to the word skills measured in the Little study although both clearly contained some form of phonetic analysis.

Correlations between both successive tasks and SDRT measures were consistent with findings from many other authors where reading problems are most often associated with poor performance in successive processing (Carlson & Das, 1992; Das, Mishra, & Kirby, 1994; Das & Siu, 1989; Kirby & Das, 1990; Kirby & Robinson, 1987; Snart, Das, & Mensink, 1988). The present results replicate the findings by Krywaniuk and Das (1976) where successive tasks were found to be correlated with individual word reading and reading comprehension in the same native population.

In general, it has been assumed that individual word reading skills are best predicted by successive tasks, especially in the early Grades, while reading comprehension is best predicted by simultaneous tasks especially in later Grades (Das et al., 1994). However, in the present study a significant relationship between reading comprehension and simultaneous processing was not found. Given the statement made previously about the problematic nature of the administration of Reading Comprehension, no firm conclusions can be drawn about the nature of these relationships. Therefore, hypothesis 1 b) can neither be rejected or accepted.

The finding that expressive attention was the only task that significantly correlated with Reading Comprehension could be due to several factors. First, attention problems could not be adequately controlled for in the subject selection, which may have skewed the results. That is, while subjects were selected to eliminate the possibility of emotional, behavioural, or neurological deficits, it is possible that sub-samples of children were left in the study who may have qualified for a diagnosis of ADHD and/or Fetal Alcohol Effect (FAE). At least the inattentive type of ADHD would have been more difficult for teacher's to identify, as inattentive children do not always display the types of disruptive behaviour that is more easily noticed by a teacher. Likewise, FAE is difficult to diagnose as it relies almost entirely upon parental acknowledgement of drinking during pregnancy, which carries with it significant stigmas regarding disclosure. The most likely effect of inadvertently including children with ADHD or FAE would be to increase variability, or else positively skew results on tests sensitive to attention and/or global learning factors. In turn, this may have increased correlations between reading measures and attention tasks.

Second, expressive attention is an articulation task and it may have been this component of the task that is related to reading comprehension. The research has generally failed to find a relationship between measures of sustained attention and reading disability (Das, 1988). However, there has been little research on selective attention measures or attention measures that have an expressive component such as the one used in the present study. One exception was a study by Das, Mishra, and Kirby (1994) which showed that dyslexic children differed significantly from non-dyslexics on several measures that included articulation, expressive attention, and phonetic analysis. We also know that dyslexia has been shown to be related to speech deficits (Das, 1991). Thus, it could be that weak articulation skills, as reflected by low scores on Expressive Attention, may be related to poor reading comprehension in this native sample.

Third, test selection bias could have played a role in this result. The present sample could be considered fairly naïve to testing situations, as this was only the second time they had experienced a standardised group test. Group tests are particularly prone to variations in attention and motivation as opposed to individually administered tests. It could be argued that a group of students who were relatively inexperienced in taking group tests could have greater variations in attention and motivation that one might expect for experienced test takers. Thus, scores on the SDRT, a group measure, could have been greatly impacted by variation in attention and motivation. This effect of group testing may also explain why there was a significant relationship between SDRT measures and CTCS measures which is also group-administered.

In terms of planning skills and reading, it was found that Planned Connections was significantly correlated with Auditory Vocabulary and Word Probe. This result is similar to that of Das, Snart, and Mulcahy (1982) who examined the relationship between reading (decoding and comprehension) and successive, simultaneous and planning processes in fourth and sixth Graders. They found strong relationships between decoding skills and successive and planning tasks (including Planned Connections) for fourth Graders. Sixth Graders showed significant correlations between decoding and simultaneous processes in addition to planning and successive processing. Lastly, they found a significant correlation between reading comprehension and only simultaneous and planning processes at both Grades.

The present results confirm a relationship between planning ability as measured by Planned Connections and word decoding skill as well as overall word knowledge. For Auditory Vocabulary, the task required students to select one of three words that corresponded to a definition read by the examiner. This task actually involved no decoding but had a comprehension component. One might consider this test a good reflection of knowledge base in the language area. This result tends to confirm the importance of planning ability for both word decoding and emphasizes the relationship between knowledge base and information processing. Given that only a single measure of planning was included in this analysis, it would be interesting to determine whether this result would hold true with other measures of planning ability.

Despite the above result it was somewhat surprising that a significant correlation was not found between planning and Reading Comprehension on the SDRT ($r=-0.15$, $p=0.31$). This is the case when we examine the research and see that planning ability has consistently been found to be correlated with comprehension measures (Das et al., 1982; Mahapatra, 1990; Ramey, 1985). Once again, the problematic administration is the most likely explanation why the expected relationship was attenuated.

Inter-correlations between CAS subtests

This result was included to show that some CAS subtests were highly inter-correlated and may share considerable variance with each other. One might expect to find significant inter-correlations between subtests that are measures of similar constructs. That is, one would expect the two successive processing tasks of Word Series and Speech Rate to be significantly related to one another. Likewise, simultaneous tasks (i.e., Figure Memory and Matrices) should be significantly correlated with one another. As only successive and simultaneous processing had more than a single measure, one might expect these measures to be highly correlated. The correlation between simultaneous measures was significant as expected. However, there was no significant correlation between successive processing tasks,. One reason for a lack of correlation between the two successive processing measures is given by Das et al. (1994) who state, "The fact that consistency has been observed, however, does not mean it should be expected, or that consistency is by any means perfect. The most likely result is that test scores will be most correlated when the tests share the maximum characteristics (eg., type of coding, content, etc.)" (p.65). The successive measures chosen for this study had clear differences. Speech Rate was timed while Word Series wasn't. Also, Word Series had a stronger memory component while Speech Rate had a stronger articulation component. Perhaps some of these dissimilarities can explain the lack of correlation between successive measures.

Significant relationships were also found between Speech Rate, Planned Connections and Expressive Attention. While each of the subtests is purported to measure a unique construct, the one commonality between these subtests is that they all involve a timed component. This result may be an artifact, as only a single measure of planning and attention were included in this study. It is also possible, as it has been debated in the literature, that timing may contribute uniquely to the variation in the performance on cognitive tasks such as the CAS provides (Keith & Kranzler, 1999). Certainly, the use of speeded tests in any cognitive battery may play a differential role depending on one's cultural group and the value the cultural group places on speed of performance (Senior, 1993).

Auditory Vocabulary Discussion

Many researchers have examined the cognitive abilities of readers with varying levels of ability. However, a majority of studies have limited their analyses to simply "good" versus "poor" readers. For the most part, good has been defined as average to above average compared to some normative group. Conversely, poor readers have been defined in several different ways including being one or two years below Grade level (Baker, Decker & DeFries, 1984; Byrne & Shea, 1979), or below the 25th percentile (Siegel, 1992). In addition, different studies have varied according to which reading measures were utilized (i.e., individual word reading, word attack, reading comprehension or some composite of these). In the present study, the groups were split into three categories, good (G) (30th percentile or above), poor (P) (5-30th percentile), and very poor (VP) (below 5th percentile). There were three reasons for this choice of grouping.

First, the native sample was underachieving as a group with a majority of readers performing well below normative levels. Second, the division of the groups into these 3 categories left roughly comparable groups in terms of sample size. Finally, the percentiles chosen correspond roughly to natural cutoff points. That is, the 30th percentile roughly equates to one standard deviation below national norms. Conversely, the 5th percentile is one and two thirds standard deviations below national norms. More practically speaking, the 5th percentile has often been used as a cutoff for severe achievement delays by school systems. One potentially negative effect of using this division of subjects into three groupings is that it inadvertently may have reduced the opportunity to find differences between the groups. Certainly by cutting out the middle group of students, you have the effect of comparing groups on opposite extremes. Conversely, the present analysis maintains the roughly normal distribution of ability level in reading, although in this case a positive skew was found for the whole sample especially for comprehension. Hypothesis two reads,

> There will be a statistically significant difference between readers of varying vocabulary ability (i.e., very poor, poor, and average) on the various CAS subtests.

In terms of the analysis for the groups based on Auditory Vocabulary scores, there were several significant results that will be discussed. First, univariate analysis and post-hoc tests revealed that the only subtests that showed significant differences between groups were Speech Rate and Word Series. In addition, post hoc tests revealed that for Speech Rate, only the VP and P groups differed with the P group showing relatively better scores. However, for Word Series, only the VP and AVG groups differed, again in favor of the latter group. To some extent the lack of significant findings for the other CAS subtests may have been due to age as a confounding variable. That is, the analysis revealed that the P group was significantly older than the AVG group and slightly, but not significantly older than the VP group. Potentially, this would have led to higher scores in the P group that may have modified any differences found between the P group and the AVG group.

Discriminant Analysis for Auditory Vocabulary Groupings

Research hypothesis three reads,

> Group membership (i.e., very poor, poor, or average vocabulary ability) will be successfully predicted, by greater than chance, based on individual's performance on CAS subtests

CAS variables were subjected to discriminant analysis to determine their ability to predict Auditory Vocabulary group membership or Reading Comprehension group membership (VP, P, and AVG). For Auditory Vocabulary it was found that CAS subtests, when entered together, successfully predicted group membership at a rate of 63% correctly classified. This rate of correct group prediction is statistically significant. However, there were still considerable false positives.

When age and CSI were added to the analysis, group prediction rose to 80% correctly classified. The inclusion of age improved predictability given the relatively wide age ranges (i.e., 7 years 10 months to 10 years 9 months) of the sample. With only age included, in addition to CAS variables, the predictability of group membership rose marginally. However, the predictability rose to 80% of the sample correctly classified when CSI was also included. It should be noted that including CSI as a variable had the effect of eliminating 13 subjects from the analysis as many subjects had incomplete CSI administrations. The loss of 13 subjects from the analysis may have been partially the reason for the change in result, it is also possible that the performance on the CSI (a group measure much like the SDRT) is highly predictive of determining performance on a group reading measure. Certainly, we already know that IQ and achievement are often highly correlated. Thus, the inclusion of a more traditional IQ measure does seem to have some predictive power for determining reading comprehension ability.

Word Probe Discussion

Research hypotheses four and five read,

> There will be a statistically significant difference between readers of varying individual word reading ability (i.e., low or high) on the various CAS subtests.

Group membership (i.e., low or high individual word reading) will be successfully predicted, by greater than chance, based on individual's performance on CAS subtests.

In regard to hypothesis four, t-test results did confirm that students with lower individual word reading ability were also significantly weaker on Speech Rate, and Planned Connections while Expressive Attention was nearly significant. These three tasks all have the common element that they are timed tests. In addition, two of the tests have an articulation component (i.e., Speech Rate and Expressive Attention). On the basis of these findings hypothesis four is accepted. However, the acceptance of this hypothesis must be considered tentative as it was also found that the Low group was significantly younger than the High group. This age effect may have served as a mediating variable in finding these differences between groups.

With respect to the results of the discriminant function analysis, hypothesis five is rejected. This is because CAS subtests, when entered together, failed to significantly predict group membership based on Word Probe scores. Likewise step-wise discriminant analysis results appear to have been mediated by age effects. That is, Speech Rate alone had the ability to significantly discriminate between Low and High individual word readers such that 67.3% of cases were correctly classified. However, with age added to the analysis predictability rose to 76.9% of cases correctly classified. This again points to the fact that age was a mediating variable in discriminating between Low and High readers for this sample.

Limitations

There were several limitations to the present research. Perhaps the most influential limitation was the utilization of a school-administered group test of reading, the SDRT. While the SDRT has good psychometric properties and has good utility for measuring reading ability, there were several factors that were problematic for this measure.

First, this native sample could be considered relatively naïve to group testing situations because group testing had only recently been attempted in this school. Second, the school staff, although well-meaning, may not have followed standardized administration instructions. Indeed, an interview with the special education coordinator after the study was completed revealed that some teachers might have read aloud items that the students would normally have been required to read themselves. Also, some teachers apparently had done some practice testing immediately prior to the SDRT administration. Both of these factors represent systematic errors that may have led to an artificial increase in many students' scores. A third factor is that the SDRT does not have a word attack measure, or the reading of nonsense words. Many of the research articles reviewed included some measure of Word Attack. Therefore, for comparability, it would have been useful to include such a measure.

A second limitation of this portion of the research has to do with the choice to establish a cut-off with the Word Probe test. While this test was more informal, it may have provided valuable insights into the reading ability of this sample. However, having chosen to establish a cut-off and not administering all three levels of the test led to a tri-modal distribution of scores and very high variability. We already know that large variability tends to have the effect of inflating correlational results (Tabachnick & Fidell, 1984). Also, we know that inferential statistics are based on the assumption of a normal distribution. The present distribution of Word Probe results violates the assumption of normality and may tend to invalidate any conclusions that are based on this assumption.

The choice to accept a convenience sample means that these results may not necessarily generalize to other native children. Also, the small sample size (N=53) was a limitation in this study for some of the statistics that were chosen. That is, small sample size tends to reduce the overall power within statistical analyses such as Multiple ANOVA designs, discriminant function analyses and multiple regression. For these analyses a guideline of at least ten cases per independent variable is often given, although some suggest five cases can be acceptable (Norman & Streiner, 1994; Tabachnick & Fidell, 1989). Some of these analyses may have aided considerably in examining the research questions within this thesis, but a decision was made to eliminate some of these statistical tests due to low power.

Another important limitation to the present study was the choice to select only six subtests from the entire CAS battery. It would have been very interesting to examine the relationship between the basic CAS battery of eight tests and reading.

A final limitation has to do with the exclusionary criteria established when selecting this sample of children. As was mentioned earlier, there was an attempt to remove children from the sample that had pre-existing diagnoses of ADHD and/or FAE. Unfortunately, it was difficult to entirely control for these diagnoses and it is possible that some children with these diagnoses remained in this study. Future studies should attempt to more carefully control for the presence of attention disorders, or FAE to more closely examine the relationship between attentional factors and reading.

Summary of Findings and Suggestions for Future Research

This portion of the research was successful in answering several questions and had several significant findings specific to this group of native children. It is possible that these results may not generalize to other native groups. These findings included:

- This sample was weakest on successive processing tasks.

- This sample tended to have significant reading difficulties as measured by the SDRT. This result was found despite the strong possibility that invalid administration biased the results in a positive direction. A majority of the children scored a full standard deviation or more below the standardization sample on all SDRT measures. By far, the weakest measure for these Grade 3 and 4 students was in terms of reading comprehension.

- Relative to IQ scores, 16.7% of children had low IQ and reading scores below the 5th percentile. These children would fit into the category of "garden variety" poor readers. Similarly, 23.8% of the entire sample had IQ's above 75 and reading scores below the 5th percentiles. These children might be more correctly classified as Learning Disabled according to the discrepancy definition.

- On the CAS, this sample performed at the low end of the average range on most subtests relative to a standardization group. The native sample scored lowest on Speech Rate, a successive and articulation task, scoring almost a full standard deviation below the mean.

- Reading performance was significantly correlated with performance on successive tasks. Thus, those who are weak in terms of successive processing are also likely to be weak in terms of reading skills and vice versa. This finding adds support to the idea that successive processing skills are important for the development of early reading skills.

- Expressive Attention and Speech Rate were significantly related to Reading Comprehension. Expressive Attention and Speech Rate are similar in that both have an articulation component and a timed component.

- In terms of the good versus poor analysis based on Auditory Vocabulary scores, univariate analysis and post-hoc tests revealed that the only subtests that showed significant differences between groups were for Speech Rate and Word Series. To some extent, this effect appeared to have been mediated by age because the Poor Vocabulary group was significantly older than both the Very Poor and Average groups.

- Groups who were either Low or High on the Word Probe test differed mainly in terms of timed CAS subtests including Speech Rate and Planned Connections. A near significant difference also existed for Expressive Attention. In all cases, the Low Word Probe group had weaker performance on CAS subtests. Speech Rate was even able to significantly predict group membership utilizing discriminant function analysis. However, all of these effects appear to have been modified by age.

In terms of future research, it would be interesting to replicate this study with another sample of native children from a different First Nation Group. The present study utilized a group predominantly from the Ermineskin Cree Nation and the conclusions likely have utility to this nation and other children with a similar language and cultural background. However, First Nations peoples are a very heterogeneous group with unique languages and cultural values. Therefore, these results cannot be generalized to all First Nations groups. Replication of these results with other unique First Nations would add further validity to these conclusions.

In addition, it would be useful to perform a similar study to the present study using the entire CAS battery of tests. It may be more useful to include an individual test of reading skills, such as the Woodcock Reading Mastery Test. At least it would be important to include some measure that includes nonsense word reading, individual word reading and a comprehension component. Including such measures would also permit more direct comparison to other available research in this area.

Lastly, due to the apparent global delays of this population in terms of reading ability, it may be useful to replicate this study with fifth and sixth Grade students. This may eliminate the problems of floor effect and restricted range in reading scores which were found in the present sample of students. While the fifth or sixth Grade students may still be delayed, one would expect that there would be less students who are performing like beginning or pre-readers.

PART B
CHAPTER 6
Introduction

It has been established that reading skills are weak in this sample of native children. It has also been demonstrated that the PASS model, as operationalized by the CAS, has some utility in helping us understand about how their cognitive ability relates to reading. Now the question remains as to how to improve or remediate students' reading skill.

Remediation of reading

According to Webster's 9th Collegiate dictionary (1991) remediation refers to the act of remedying. The primary definition of remedying refers to "a medicine, application, or treatment that relieves or cures a disease" (p.996). As Johnson and Allington (1991) point out, "remedial" has a medical connotation and the term is now being used to refer to the individual receiving instruction rather than the instruction itself (as in a "remedial" student). They also point out that many remediation programs are flawed or problematic when they: a) involve less rather than more reading time; b) put less emphasis on actual reading of books and more on work sheet and drill activities; c) use untrained professionals or aides to work with students; and d) reinforce the negative aspects of poor readers. As Syrus has so aptly stated, "Some remedies are worse than the disease."

While the above are all valid criticisms of remediation in general, this is clearly not an exhaustive list. Certainly, another important criticism of remedial programs is the lack of theoretical underpinnings for many remedial programs. Das, Naglieri, and Kirby (1994), after reviewing considerable research related to the remediation of reading disability, suggest that "most of the remedial programs are not supported by either hard or consistent evidence in regard to their efficacy, and the majority of them are based on no theory at all or on poorly conceived theory" (p. 155).

In direct response to these criticisms, Das and his colleagues have developed a remedial program that is based on a well-conceived and tested theory, namely the PASS model. This remedial program is called the PASS Reading Enhancement Program or PREP. PREP is the result of many years of research and development and has been subject to considerable refinement and testing. PREP is based on the PASS theory but also follows the theoretical models of instruction as proposed by Vygotsky. That is, PREP takes into account the importance of socio-cultural influences in learning and emphasizes the importance of inductive learning. Inductive learning is the notion that instruction tends to be more effective when it is internalized by the learner rather than explicitly taught by a teacher.

Over the 25 years in which PREP has been developing, there have been significant modifications and revisions to arrive at its current published format (Das, 1999a). Developments of PREP have been based on numerous studies which show that individuals who receive PREP, or remediation similar to PREP, show significant improvements in reading and cognitive skills (Brailsford, Snart, & Das, 1984; Carlson & Das, 1997; Crawford & Das, 1992; Das, 1993b; Das, 1999b; Das, Mishra, & Pool, 1995; Das, Parrila, Kendrick, & Kirby, 1996; Krywaniuk, 1974; Krywaniuk & Das, 1976; Snart, 1990; Spencer, Snart, & Das, 1989). We also know that PREP has shown positive results with various other cultural groups (Molina, Garrido, & Das, 1997; Perez-Alvarez & Timoneda-Gallart, 2000). However, the current version of PREP has never been tested with a native population. Thus, the first goal of Part B is to test the effectiveness of PREP in improving reading ability with another culturally unique group that happens to be weak in reading skills as a group.

Those who do remediation work are faced with another interesting problem which is predictability. That is, can we predict who will, or won't, benefit from remediation? From Part A, the relationship between cognitive skills and reading was closely established. Thus, the second goal of Part B is to determine what factor or factors will help predict which students will gain as a result of remediation.

In summary, the goals for Part B are twofold. The first goal is to determine whether students who receive PREP will show significantly greater improvement in reading skills than children who received only regular classroom instruction. In other words, how well will the PREP program do in helping to improve native children's cognitive and reading skill. The second goal is to determine what factors will predict how well students will respond to PREP.

Relevance

The primary relevance of this portion of the research is that it has the opportunity to assist the participants in their cognitive functioning and their reading skill. Rather than just describing and examining relationships between cognitive processes and reading, this portion of the research has an opportunity to offer practical help to students who could really benefit from this sort of help.

Similar to Part A, there has been a paucity of research utilizing the PREP with this particular cultural group. With the exception of Krywaniuk's study in 1976, no study has been found which has attempted to improve cognitive processes from the theoretical framework of the PASS model in order to assist with reading ability. The present study would add considerably to the research on the effectiveness of PREP in a cross-cultural setting.

CHAPTER 7

Literature Review

Introduction

This chapter will focus on the relevant literature relating to the remediation of reading problems and improving reading skills. As was the case for Part A, the literature relating to remediation is vast and an exhaustive review is not the goal of this chapter. Rather, the present chapter is designed to present a representative portion of the literature as it relates to the goals of the present research. The first section contains a review of the contributions from Part A. This review will help establish appropriate expectations and test various hypotheses regarding remediation. The second section presents an examination of the research on the acquisition of reading skills. Certainly, one must first understand this process in order to understand how a remediation program can be effective. In the third section, a review and critique of the various models of remediation that currently exist will ensue. There are hundreds of individual programs for the remediation of reading available today. Rather than focussing on individual programs, this research review will focus on the major types of remediation including phonological awareness programs, speech-based programs, reading recovery, and metacognitive programs. In the fourth section, the PASS Remedial Educational Program, or PREP, will be described in detail. This will include a discussion of PREP's origin including the role of memory, culture and educational deprivation, matching learning styles and teaching, and Vygotskian perspectives on learning and transfer of learning. Research supporting the efficacy of PREP will also be presented in this section. In the fifth section, the goals for the present research will be presented.

Contributions from Part A

While the information from Part A could be used to help develop a more effective remediation program, the purpose of reviewing the contributions from Part A is more to confirm the utility of the PASS model, and to set-up appropriate predictions about the effectiveness of the remediation.

The goals of Part A were threefold. The first goal was to describe the cognitive abilities of Native children using the Planning Attention Successive Simultaneous (PASS) model as operationalized by the Cognitive Assessment System. The second goal was to examine the relationship between these cognitive abilities and various aspects of reading ability. The third goal was to determine whether reading ability could be predicted based on cognitive ability.

The first goal of Part A provided information about cognitive strengths and weaknesses that may inform us about native learning style. In the literature it has been emphasized that instruction not only misses the mark as far as cultural relevance, but also in terms of teaching that matches a unique learning style (Stokes, 1997). As was explored in Part A, a common finding for many Native groups has been the presence of a predominantly simultaneous learning style (Brescia & Fortune, 1988; Krywaniuk & Das, 1976; Moore, 1989; Walker, Dodd & Bigelow, 1989). That is, these studies have reported that Native children tended to show strengths in terms of simultaneous information processing and learn more easily if they are provided with an overall picture of a situation. Indeed, this finding was replicated with the present sample of Canadian Cree children who showed a relative strength on simultaneous as opposed to successive processing on the CAS.

Now the PASS model, as it relates to reading, hypothesizes that both successive and simultaneous processing are required for successful reading. Therefore, it follows that populations that tend to be weaker in one or the other of these skills will have more difficulty learning to read. Indeed the literature has consistently found that deficits in one or the other of these processing skills are related to, and in fact predictive of, corresponding reading difficulties (Bournot-Trites, Jarman, & Das, 1995; Das, 1993; Das, Mishra, & Kirby 1994; Das, Mok & Mishra, 1994; Das, Nanda, & Dash, 1996; Little, et al., 1993; Mahapatra, 1990; Parrila & Kirby, 1998; Parrila & Papadopoulos, 1996). In fact, the current sample of native children scored below average relative to national norms on all of the subtests of the PASS. In addition, they scored nearly a full standard deviation below national norms on Speech Rate, a successive task.

The second goal from Part A was to describe how performance on the CAS relates to native reading ability. In this regard, correlational analyses generally confirmed the strong relationship between successive tasks and reading measures. More specifically, Word Series, a successive processing task, was significantly related to Auditory Vocabulary scores. Speech Rate, another successive task, showed significant correlations with all reading measures of the SDRT with the exception of Auditory Discrimination and Phonetic Analysis. Conversely, neither of the simultaneous processing tasks showed a significant relationship with any of the reading measures. This demonstrated that, for this sample of native children, those who tended to have difficulty with successive processing ability also had more difficulty with reading skills as measured by Auditory Vocabulary, Reading Comprehension and an informal Word Probe.

Word Probe, the informal reading measure, was significantly related to Speech Rate, Planned Connections and Expressive Attention. The strongest relationship was between Word Probe and Speech Rate. This relationship was strong enough that Speech Rate formed a discriminant function that was able to significantly predict whether a reader in a Low or High Word

Probe group. However, the nature of the relationship between CAS subtests and Word Probe was mediated by the effects of age as the Low group was significantly younger than the High Group.

In relation to the third goal of Part A, the finding that successive tasks were significantly related with reading measures sets up one important implication for remediation. The implication is that helping these students to improve in terms of their successive processing ability should significantly improve reading ability. One might also expect that those students who made the greatest gains in successive processing would also make the greatest gains in reading skill.

What of the role of simultaneous processing for this sample? From Part A, the relationship between simultaneous processing and reading was non-significant. This weak relationship was even found for reading comprehension, where past research has commonly found a strong relationship with simultaneous processing skills. It was concluded in Part A that this sample of native readers, being significantly delayed overall, may have been more like beginning readers and thus relied more heavily on successive processing for reading comprehension. The implication this has for remediation is that these students need to first develop successive processing skills, which is their primary area of deficiency. While successive processing skills are becoming more proficient, individual word decoding can also become more automatic and simultaneous processing can become the appropriate strategy to use for reading comprehension. At this point, those who are stronger or more proficient in simultaneous processing will have the advantage for comprehension exercises. For the present research, the prediction is that those students who progress primarily in successive processing but also maintain or develop stronger simultaneous skills will show the greatest improvements in reading comprehension.

Reading Acquisition

Reading acquisition in this context refers to the typical process in acquiring reading skills over the course of an individual's development. There are several issues relative to reading acquisition. One issue involves causality. This is the proverbial "chicken and the egg" problem. That is, many studies have been conducted with the goal of determining which cognitive factors are requisite for the task of reading. The problem with this undertaking is that, even with longitudinal research, studies can only show what is associated with reading and future reading success. The causal relationships underpinning such associations are indeterminate (Cataldo & Ellis, 1988; Ellis and Large, 1988). As is generally known, there are four possibilities when one finds a correlation between reading and some ability, (1) the ability is a pre-requisite to reading,

(2) the ability facilitates reading, (3) the ability is a consequence of reading skill, and (4) the ability is just an incidental correlate and some third factor is causal to both (Ehri, 1995).

As shall be seen in later sections, the PASS theory, and ipso facto PREP, holds that cognitive processes such as successive and simultaneous processes underlie both phonological ability as well as reading ability. In other words, PASS theory is a top-down explanation for how reading, or any other ability, develops. The hypothesis is that one must first possess successive and simultaneous processing skills, have sufficient cortical arousal and the ability to attend, as well as having the ability to plan meaningfully, prior to individual skill development. Deficits in any of these processes can lead to problems in skill acquisition including reading.

In contrast, many researchers have looked at reading acquisition from a more bottom-up perspective. That is, research has tended to focus on various aspects of print and print-sounds associations and our ability to integrate these subcomponents necessary for reading. Therefore, numerous researchers have examined the relationship of reading acquisition to skills such as phonological awareness, phonological recoding, knowledge of letters, visual-symbolic short term memory skills, working memory, use of syntactic, semantic and pragmatic information, and orthographic skills.

By far, the strongest associations with reading or in predicting reading have been found with phonological skills such as general awareness, decoding, and recoding skills (Bruce, 1964; Bryant, Bradley, Maclean, & Crossland, 1989; Fox & Routh, 1980, 1984; Jorm & Share, 1983; Kirtley, Bryant, MacLean, & Bradley, 1989; Liberman, Shankweiler, & Liberman, 1989; Leong, 1992; MacLean, & Bradley, 1989; MacLean, Bryant, & Bradley, 1987; Shankweiler et al. 1995; Share, 1994; Torgesen et al., 1989; Wagner & Torgesen, 1987; Wagner et al., 1993). Clearly, the importance of phonological skills is essential in any model of reading acquisition, although there is still considerable debate about the precise role phonological skills play in the development of reading. What follows is an examination of the various models of reading acquisition.

Models of Reading Acquisition

Several models have been proposed which attempt to explain the process of reading acquisition. Stage theories have been popular in the literature and typically involve either three or four discrete stages of reading development (Ehri, 1979, 1991, 1994, 1995; Ellis, 1985, 1993; Ellis & Large, 1987, 1988; Marsh, Friedman, Welch, & Desbery, 1981). One model presented by Ehri (1979, 1987, 1991, 1994, & 1995) describes four phases of the development of reading including: a) a visual cue phase, b) a rudimentary alphabetic phase, c) a mature alphabetic phase, and d) a spelling pattern phase. Ehri postulates that, rather than phonological sensitivity being a precursor or consequence of reading, there is an interaction between the two. That is, Ehri suggests, along with others, that phonological sensitivity is both a consequence of and a contributor to learning to read (Ehri, 1979; Perfetti et al., 1987).

Ellis and Large (1988) also suggest a four stage model of reading acquisition based on a two year longitudinal study of 40 children. Their four stages were roughly equivalent to the phases presented by Ehri. Stage 1 of reading is described as a pre-reading stage where phonological awareness, letter recognition, and visual short-term memory predicted reading development over the next year. Stage 2 is termed the logographic stage and involves holistic visual perceptual skills. Stage 3, which occurs around 6 years of age, is when reading skills become more strongly associated with phonological awareness, sound-symbol decoding and auditory-verbal short-term memory. Other theorists have termed this stage sequential decoding (Marsh, et al., 1981), or alphabetic (Frith, 1986). Stage 4, which occurs around age 7, involves the more extensive development of grapheme-phoneme correspondence rules.

However, stage theories have not fared well under scrutiny and are filled with inconsistencies. On the one hand, evidence has been found which supports direct visual access (Bryant & Bradley, 1983; Jorm & Share, 1983) while others have found evidence of an early reliance on phonological recoding together with a developmental shift toward direct visual access (Reitsma 1984). As Share and Stanovich (1995a) state, "The notion that children must first pass through a print-to-sound recoding stage is left unresolved by this body of evidence. Indeed, the conflicting findings are equally problematic for *any* stage-based model, whether phonological-to-visual or visual-to-phonological." (p.15, italics theirs).

Perhaps the answer to this unresolved issue is that neither direct visual access nor phonological processes come first. From a PASS theory perspective both phonological and visual skills are guided by their respective processing codes. PASS theory states that phonological information, which is auditory by nature, will tend to be processed mainly through successive means. Conversely, visual information tends to be processed predominantly through simultaneously modes. However, the skill of reading is guided by the dynamic interaction of these ways of processing and coding information in relation to the child's existing knowledge base. More about how PASS relates to the acquisition of reading will be presented later in this section.

In contrast to stage-based theories is a process-oriented theory called the "Self Teaching Hypothesis" of reading acquisition. This theory was first suggested by Frith (1972) then later developed by Jorm and Share (1983; Share & Jorm, 1987; Share & Stanovich, 1995a; 1995b).

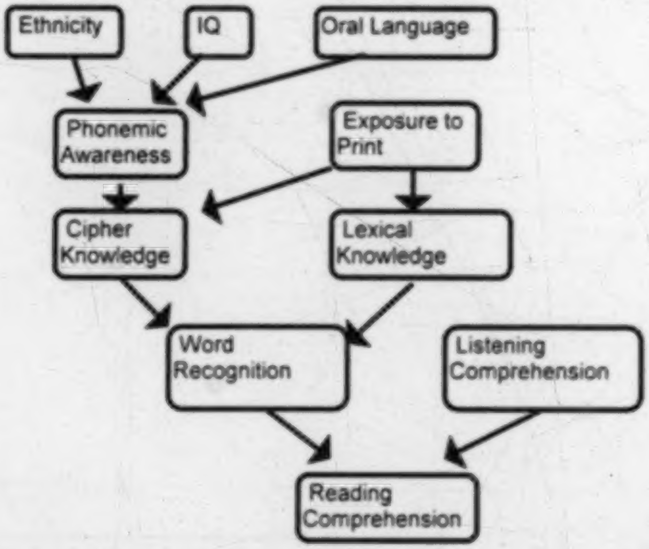
The self-teaching hypothesis essentially holds that reading skills are acquired naturally through successful decoding encounters with novel letter strings. While the authors acknowledge that phonological recoding may not play a central role in skilled word reading, they hold that phonological recoding, by virtue of its self teaching function, is critical to successful reading acquisition (Share, 1994). Further, they state that early self teaching depends on letter-sound knowledge, minimal phonological sensitivity, and the ability to use contextual information to determine exact word pronunciations on the basis of partial decoding (Share & Stanovich, 1995a).

One of the criticisms of the self-teaching hypothesis is that it does not necessarily take into account what happens prior to decoding, when children are just discovering concepts like symbolic representation. That is, self teaching does not adequately account for what happens early in the reading experience of an individual. Share & Stanovich (1995a) state that self-teaching depends on adequate letter-sound knowledge, phonological sensitivity and the ability to use contextual information. However, there is no attempt to account for the development of these abilities within their theory.

Another model of reading acquisition was proposed by Juel, Griffith, & Gough (1986) and is referred to as the "Simple View" model of reading acquisition (see Figure 7.1). It has been described as the Simple View by the authors as they state that the model only contains those influences on reading which they consider to be primary (Gough, & Juel, 1991; Juel et al., 1986). The Simple View holds that reading is composed of decoding (i.e., learning to break the code of written text by being aware that words are composed of sequences of meaningless and somewhat distinct sounds (Juel, 1988)), and listening comprehension. In turn, they posit that decoding skills are composed of the orthographic cipher and lexical knowledge. The orthographic cipher consists of, or is primarily influenced by, phonemic awareness as well as experience with print. They argue that IQ, culture and oral language ability are the primary influences on the development of phonemic awareness. They state that phonemic awareness, in conjunction with exposure to print, helps contribute to cipher knowledge especially in early reading. However, they state the phonemic awareness needs to be in place prior to exposure to print in order for a child to gain cipher knowledge.

Support for this model was provided by the authors in the form of a four year longitudinal study where they found support for the primacy of phonemic awareness and path analysis supported the model (Juel et al., 1986; Juel, 1988). Recent research has been able to cross-validate some of these initial claims (Kirby, 1999; Kirby & Parrila, 1999; Parrila & Kirby, 1998).

Figure 7.1 The "Simple View" Model of Literacy Acquisition



Adapted from Juel et al., 1986. Note that the role of written language skills has been omitted from this diagram.

Other researchers have emphasized the importance of orthographic factors in the acquisition of reading (Fletcher, 1991). Although the research has tended to support stronger relationships between phonological skills and reading than orthographic skills and reading, orthographic skills clearly play an important role in beginning reading. At least it has been demonstrated that phonemic segmentation ability is a necessary, but not sufficient, condition for rapid reading acquisition (Juel, et al., 1986). The reasoning is that if phonological sensitivity is necessary but not sufficient there must be some other cognitive ability that can explain reading acquisition. Orthographic processing skill is the area where many researchers have looked for this relationship. Some researchers have succeeded in finding independent contributions of orthographic skills to word recognition even after phonological processing skill contributions have been partialled out (Cunningham & Stanovich, 1990; McBride-Chang, Manis, Seidenberg, Custodio & Doi, 1993). However, a cross-cultural study examining the importance of orthographic factors among American, Chinese, and Japanese readers failed to support the role of orthographic factors in reading disabilities (Stevenson, et al., 1982). Perhaps some other underlying cognitive factor could explain individual differences in phonological and orthographic skills necessary for reading.

The PASS Model of Reading Acquisition

One model that proposes that there are underlying cognitive processes that mediate any cognitive skill such as reading is the PASS model. Kirby (1988) has argued that reading develops along eight distinct levels of increasing complexity, where successive and simultaneous processing are the modes which allow information at one level to be transformed to another level. These eight levels include recognition of letter features, letters, sound or syllable units, words, phrases, ideas, main ideas, and themes. At each level the items of information must be first recognized (simultaneous processing) and then ordered (successive processing) so that higher level units can then be recognized (simultaneous). Subsequent research has shown that this conceptualization is essentially correct, however planning and attention are also important in reading decoding skills (Bardos, 1988; Das, Bisanz, & Mancini, 1985) and especially for comprehension skills in later Grades (Das, Snart & Mulcahy, 1982; Ramey, 1985). More information of the relationship of PASS processes to reading will be presented later in the section on PASS and Reading.

After examining the various different models of reading acquisition, it can be seen that most of the models are bottom-up approaches where the emphasis is on understanding the role of phonological or orthographic factors in relation to reading. Yet the question remains as to whether there are independent underlying cognitive processes that mediate the acquisition of phonological and orthographic skills. The PASS model is a top-down model that purports the mediation of phonological and orthographic skills. It is top-down in that it is hierarchical, where there is an interaction between a person's existing knowledge base and their cognitive processing strategy when approaching any given task. Before examining this model as it relates to remediation in greater detail, a review of the reading remediation literature is presented.

Models of Reading Remediation

The types of reading remediation programs are numerous ranging from Reading Recovery programs (Center, Wheldall, Freeman, Outhred & McNaught, 1995; Clay, 1985; Iversen & Tunmer, 1993; Juliebo, Norman, & Malicky, 1989), to metacognitive remediation programs (Bret & Bereiter, 1989; Cheong & Mulcahy, 1996; Cross & Paris, 1988; Kucan & Beck, 1997; Malicky, Juliebo, & Norman, 1994; Silven, 1992) and an extension of metacognitive strategies called think-aloud protocols (Jimenez, Garcia & Pearson, 1995, Johnson & Allington, 1991; Maarit & Vaurus, 1992; Silven & Vauras, 1992). The most widely used and researched approach to remediation has included some aspect of phonological awareness training (Ball & Blachman, 1991; Barker & Torgesen, 1995; Blachman, Ball, Black, & Tangel, 1994; Byrne & Fielding-Barnsley, 1991; 1993; Fox & Routh, 1976; Gittelman & Feingold, 1983, Hatcher, Hulme & Ellis, 1994; Hurford, et al., 1993; Hurford, Schauf, Bunce, Blaich, & More, 1994; Huxford, 1996; Iverson & Tunmer, 1993; Lovett, Warren-Chaplin, Ransby, & Borden, 1990; Mantzicopoulos, Morrison, Stone, & Setrakian, 1992; Olson, Wise, Conners, & Rack, 1990; Rack, Hulme, & Snowling, 1993; Vellutino et al., 1996; Williams, 1980). Each of these approaches will be examined in turn.

Reading Recovery. Clay (1985), who viewed reading as a psycholinguistic process in which the reader constructs meaning from print, first developed Reading Recovery. This model is based on a conceptual framework that includes perceptual analysis, knowledge of print conventions, decoding, oral language, prior knowledge, reading strategies, and metacognition, as well as error detection and error correction strategies. The essence of Reading Recovery is daily, intensive involvement of children in "real" reading experiences. The idea of this approach is to overcome what Stanovich (1986) and others refer to as "Matthew effects" in reference to the passage in the Gospel according to Matthew "For everyone who has will be given more, and he will have an abundance. Whoever does not have, even what he has will be taken away from him" (25:29, NIV). This analogy in relation to reading espouses that poor readers get poorer and good readers get better.

In evaluating Reading Recovery (RR), Juliebo et al. (1989) found improvement in a small number of Grade 1 and 2 children following the program. However, RR has been widely criticized on methodological grounds as well as its apparent failure to include systematic training in phonological recoding skills (Iverson & Tumner, 1993). Methodologically, RR has been criticized for a lack of adequate controls, lack of generalizable measures, and establishment of lasting gains (Center, Wheldall & Freeman, 1992). In a more recent study by Center et al. (1995), they found that 35% of the children studied benefited from the program, another 30% would probably have recovered without such intensive individualized intervention, and 35% remained unrecovered. They conclude that, "while RR stresses the importance of using all sources of information available to access meaningful text, it may not provide enough systematic instruction in the metalinguistic skills of phonemic awareness, phonological recoding, and syntactic awareness for students to acquire these processes." (p.244).

Metalinguistic Awareness and remediation. Metalinguistic awareness refers to "the ability to perform mental operations on the products of mental mechanisms involved in sentence comprehension; that is, the systematic phones, the words and their association meanings, the structural representation of sentences, and the sets of interrelated propositions" (Tunmer & Fletcher, 1981, p. 175). Some researchers have delineated two broad categories of Metalinguistic awareness: self appraisal of cognition and self-management of cognition (Cross & Paris, 1988). Gagne, Yekovich and Yekovich (1993) point out that self appraisal includes a declarative component (i.e., what factors affect reading), and a procedural component (i.e., how strategies operate). Cross and Paris (1988) add a third component of conditional knowledge, which refers to why and when to use strategies. The self-management of cognition includes planning, evaluation and regulation. In terms of how these concepts fit with the PASS model, both self-appraisal and self-management are concepts which seem to fit very well. The former is very similar to the concept of a person's knowledge base in the language area. The latter is similar to the planning component of the PASS model.

Research on metalinguistic awareness has generally supported a relationship with reading ability and reading acquisition (Ehri, 1979). However, we also know that metalinguistic awareness develops rather late in comparison to language acquisition (Mancini, Mulcahy, Short & Cho, 1991). This implies that remedial programs that utilize metalinguistic awareness training have their greatest utility in improving reading comprehension skills rather than decoding. Indeed, it has been amply demonstrated that children can learn to be strategic readers (Pressley & Wharton-McDonald, 1997). However, one such program called ISL showed limited benefit in post training measures with less skilled readers (Cross & Paris, 1988). An explanation for this may be that, for less-skilled readers, the decoding process has not been sufficiently automatized for understanding beyond the word level to occur. For the past 25 years, researchers have supported the notion that individual word decoding must be fairly automatized for reading comprehension skills to develop (Das et al. 1994; Gagne et al., 1993; LaBerge & Samuels, 1974; Pressley, 1990).

A similar approach to metacognitive strategies is the cognitive adaptationist approach. This viewpoint holds the key assumption "that the cognitive strategies of learning-disabled children represent adaptive solutions to immediate problems that confront them. Remedial instruction, accordingly, cannot simply try to improve children's strategies or to train missing skills. The remedial teacher must help the child develop other strategies that are adapted both to immediate problems and to long-term needs" (Brett & Bereiter, 1989, p.281). One of the tenets of this approach is the idea of promoting intentional learning in a collaborative fashion where the learner can progress relatively independently from their instructor or the instruction. This notion is very similar what Vygotsky's well-known notions of internalization and verbal mediation. Internalization is the notion that a child needs to internalize instruction and make it part of his/her own thinking. This idea, and several other ideas borrowed from Vygotsky, is a central part of the PREP program, as we shall see in a later section.

Think-Aloud approach. The think-aloud approach to reading remediation is a type of metacognitive approach to help children read for meaning. Think-alouds are thought to reveal information about a student's interpretation of text and reading comprehension that is not always readily visible using other methods (Jimenez et al. 1995). The advantage this has for instruction is that novice readers can benefit from observing more experienced readers and might infer principles for more developed reading (Kucan & Beck, 1997). Research with sixth Graders by Silven and Vauras (1992) and Silven (1992) suggests that think-aloud protocols have the potential to improve reading especially when the trainer modeled the think-aloud and guided students through the activity. As shall be seen in a later section, PREP actively encourages students to think aloud although this is not a central tenet of the program.

Phonological Approaches to Remediation. As mentioned previously, phonological approaches to remediation of reading problems are by far the most common and most researched approaches. From Part A, we already know of the importance of various phonological processes in the prediction of successful early reading ability. Phoneme identity, elision (i.e., the omission of an initial or final sound in speech), segmentation, letter-name and letter-sound knowledge, sound discrimination, and rhyme have all been incorporated into phonological remedial programs. Some programs have emphasized only one discrete skill along the phonological dimension while others have developed programs to address some combination of these skills.

Hurford (1990) found that phonemic discrimination training could improve phonemic segmentation ability. A later study by the same author and his colleagues (1994) showed that early identification of children who were at-risk for reading problems, and the subsequent remediation with phonological training in segmenting and blending, could improve reading ability (word identification and word attack). However, there is still the question of what to do with those students who have persistent reading problems or who are not identified as having problems early in their development.

Ball and Blachman (1991) conducted a study examining how remediation of a distinct phonological skill could improve reading. In their study, subjects received either letter-names or sound training alone, or in combination with training into the segmentation of phonemes into words. They found that letter name and letter sound training without training in phonemic segmentation skills was not sufficient to improve early reading skills.

In regard to another discrete skill, namely phoneme identity training, Byrne and Fielding-Barnsley (1991, 1993) developed a program that emphasized the recognition of phoneme identity over other phonological processes. Phoneme identity refers to the ability to identify that two different words either begin or end with the same sound. These authors clearly showed that recognition of phoneme identity can be successfully trained and that understanding of phoneme identity by the end of kindergarten predicted successful reading of real and pseudowords and spelling ability three years later. However, they also noted that of out of 45 children who were able to pass phoneme identity and letter-knowledge by the end of kindergarten, nine children failed on a word choice test. They concluded that phoneme identity is a necessary but not sufficient skill for early reading.

This is a conclusion that was shared by Gittelman and Feingold (1983) who remediated 61 children between the ages of seven and thirteen who were two years below reading level. Remediation involved either phonics training alone or in combination with methylphenidate (more commonly known as Ritalin). The inclusion of methylphenidate was done to determine whether attention deficits could be contributing to reading problems. The results from this study indicated some improvement in reading ability following the phonics-only program and non-significant changes in reading with the addition of the drug. However, when looking at the results more closely the authors note that many of the children, although they made positive gains, would still have qualified for the study at the end of the program. That is, they were not yet "normal" or average readers. They conclude more broadly that, "an exclusively phonetic approach to the remediation of reading disability may be insufficient to transmit the skills necessary for the mastery of broad reading skills" (p.187).

Carrying this research one step further, Hatcher et al. (1994) set out to test whether phonological training linked with training in Reading Recovery would provide greater gains in reading. They refer to their theory as the phonological linkage hypothesis, which states that explicit links between reading activities and phonological knowledge are necessary to achieve greater transfer of learning to new reading activities. Their 1994 study essentially confirmed that a group receiving a combination of Reading Recovery and phonological training outperformed a Reading Recovery group and phonologically trained group. They also state, "Our data support the more subtle position that adequate phonological skills may be necessary, but not sufficient, for learning to read effectively" (p.53). Their notion of providing "links" between process skills and reading are very similar to the notion of "bridging" used in the PREP program. Transfer of learning is discussed in a later section of this chapter while the bridging tasks for PREP are described in detail in chapter 8.

Some programs have examined the effect of training either phonemic analysis, or synthesis, or both, on word reading (Barker & Torgesen, 1995; Fox & Routh, 1976; Huxford, 1995; Lovett et al. 1990; Barker & Torgesen; 1995; Williams, 1980). Analysis refers to such skills as knowledge of rhyme, recognition of syllables, segmentation ability, and letter-sound knowledge. Synthesis refers to blending skills or the ability to blend individual phonemes into words.

Fox and Routh (1976) developed one of the first such programs to enhance analysis and synthesis skills. Their program was tested on four year old children and it was found that phonemic segmentation, an analysis skill, was necessary for students to benefit from blending training. Children proficient in both analysis and synthesis skills seemed to learn new words faster.

Williams (1980) examined another such program, referred to as the ABD's of reading, on a population of learning disabled children. She found that training in analysis skills and blending led to transfer in the ability to decode novel combinations of letters, especially for non-words, after three consecutive years of instruction. However, the subject selection was drawn into question by the researchers themselves as these children were identified as learning disabled by nomination from school authorities. In addition, subsequent research has failed to find such strong findings.

A similar approach to training analysis and synthesis skills was used by Barker and Torgesen (1995). They utilized a computer-based model of instruction to teach analysis and synthesis skills. The reader is referred to articles by Barker and Torgesen (1995) or Leong (1996) for a good review on the use of computer programs that provide training in phonological awareness, specific context-free word identification skills, and reading. The specific programs developed by Barker & Torgesen (1995) are called Daisy Quest and Daisy Castle. These programs were tested on first Grade poor readers. Results showed improvements in word identification after the program but not in word attack or the ability to read nonsense words. The finding of no improvement in word attack is unusual given that the training of phonological awareness and analysis skills was an explicit goal, and word attack is designed to measure these skills. Their conclusions were that Daisy Quest could improve overall reading ability. However, this conclusion seems too ambitious and would require replication and longitudinal studies to confirm the result.

A final example comes from Lovett et al.'s (1990) study, where they attempted to train grapheme-phoneme correspondence. They found that familiar words were better recognized after training but there was no post-test advantage on uninstructed reading vocabulary, on rhyme ability and pseudoword reading. They conclude, "Disabled readers ... did not abstract from item-specific learning a set of invariant patterns to facilitate their recognition of unfamiliar words and pseudowords." (p.777). Olson et al. (1990) in a meta-analysis and subsequent study of the grapheme-phoneme segmentation, went one step further and concluded, "grapheme-phoneme segmentation was the least helpful aid for word learning".

In summary, the body of research examining the effectiveness of various phonologically-based remedial programs has generally confirmed that phonological skills can be trained, whether they involve analysis (letter-sound knowledge, rhyme knowledge, segmentation, phoneme identity) or synthesis skills (blending). However, a careful analysis of the results suggests that while phonological skills are certainly necessary for developing reading ability, the training of phonological skills in isolation may not be sufficient. Also, it could be stated that if comprehension ability were the aim of remediation, then phonological methods are necessary but not sufficient. Another problem involves transfer. While some programs have shown positive results with skills that were specifically trained, or with familiar words, few studies have been able to show transfer to unfamiliar words in addition to pseudowords. One possible conclusion of this review is that phonological coding training, without including some training of the underlying processes that determine these skills, may not work to achieve lasting and far-reaching transfer. It is possible that phonological deficits may be a symptom of an underlying cognitive processing deficit. This is the contention of the PASS theory of intelligence and the impetus for the PREP remedial program. In the next section is a review of the research that was the foundation for the development of PREP.

Towards a Model of Remediation

As mentioned in the introduction, the PREP program has its roots in four areas. These include research into memory, sensory deprivation, learning styles and concepts from Vygotsky's work. Each of these will be examined in turn.

Contributions from memory research. The first root in the PREP model comes from research into the structure and control of memory. Many of the ideas for remediation, which were utilized in the PREP program, came from the research of Atkinson and Shiffrin (1968) who proposed a box model of long and short-term memory processes. In terms of control processes, rehearsal and chunking of information has long been recognized and utilized to enhance the encoding of information. To teach these strategies researchers have tried direct instruction, modeling, fading and prompting all with limited success in the transfer of these skills. Some researchers have suggested that children require understanding of the need for, and uses of, particular strategies before those strategies can be properly learned and internalized (Paris et al., 1984).

In relating the PASS theory to memory, Chapter 2 already described the relation of working memory to successive and simultaneous processing. In terms of long and short-term memory, Das et al.(1994, p. 59) state,

> "How do successive and simultaneous processing relate to the features and divisions of memory referred to earlier? Both types of processing occur in working memory, and the results, simultaneous and successive codes, are stored in LTM (long-term memory). It is important to recognize that we are not identifying successive processing with STM (short-term memory), even though many of the tests that measure successive processing involve STM. Depending on the nature of the material and the subject's knowledge base about it, simultaneous processing is just as likely to be involved with STM. ... Auditory information is by its very nature presented successively, while visual information is presented simultaneously; however, once the information enters working memory, mode of presentation becomes irrelevant, or at least less relevant than what is done to the information, that is, the type of processing applied to it. Both simultaneous and successive processing may be applied to information that is verbal or spatial, episodic or semantic."

In relating rehearsal and chunking strategies to the PASS model, rehearsal essentially serves the purpose of establishing automaticity. When something that once required successive processing becomes automatic enough, simultaneous processing takes over until new information is encountered that needs to be organized and structured. In terms of levels of coding this means that as higher levels of coding are attained, more and more raw information is represented by a single code. This frees up working memory space to order, structure, and organize the preceding codes until the next higher level of analysis is performed to produce or recognize the pattern that is the basis for the higher level code. Chunking, on the other hand, is a strategy that assists in the organization of codes so that greater capacity and higher level analysis can take place.

There are many other strategies for moving information from STM to LTM. Mnemonics, pegging, pigeonholing, categorical clustering, and acrostics are all common memory strategies. For PREP, the emphasis is less on the utilization of a particular strategy than on helping the children to develop and internalize any successful strategy. The process by which this happens is discussed in the section on transfer.

Sensory deprivation. This is the second root of the PREP program which stems from work by Hebb on sensory deprivation. It is well known that sensory deprivation has a negative impact on cognitive growth. Taking this work a step further, Das (1992) has argued that cultural deprivation can have a similar impact on individuals. For the present sample, while one could never characterize the native people as being culturally disadvantaged in the sense that their cultural roots have less value, there has certainly been a poverty in opportunity for education and a differing value placed on "white-man" education. Another factor has been the unfortunate historical efforts to suppress their native language. Required to learn a language that is not their own and punished for breaking this rule, some natives have justifiably developed a resentment for North American schools and language education. In fact, it has been empirically shown that formal schooling has had a negative impact on Cree syllabic literacy (Bennett, & Berry, 1987; Berry & Bennett, 1989). More recently, schools are making valiant efforts to include native-language instruction as part of the curriculum. Unfortunately, the damage may have already been done, as many native children and adults have only a rudimentary understanding of their own language in addition to struggling with English. As mentioned in Part A, this is the case of the complex bilingual, who cannot master either language.

Native learning styles. The third root for remedial training lies in the matching of learning styles and teaching strategies. The research regarding native learning styles was previously reviewed in Chapter 2. The reader is referred to that chapter for a more detailed description of the research. For this section, the emphasis will be on how native learning styles, or learning styles in general, inform us about remediation.

The primary question in matching learning style with instruction is whether to try to overcome weaknesses or utilize the existing strengths of a student. Much of the impetus for examining native learning styles has come from findings that native children as a group consistently score below national norms on standardized testing (Guilmet, 1983; Senior, 1993; Smith, 1992, Vernon, Jackson, & Messick, 1988). Despite the evidence that natives tend to have some distinct learning styles, there has been some who point out that the term "learning style" is ambiguous (Sawyer, 1991). In addition, there are some who claim that the research fails to support the notion that adaptation of instruction to learning styles leads to increased achievement (Kleinfeld & Nelson, 1991). Despite this, More (1989) suggests that teaching style should be matched to learning style and that improvement of weaker learning style is the most appropriate for native people. More generally, Kirby (1988) suggests that remediation of weaker processes may be the best choice but only if the weak processes can be accurately identified.

It is this latter notion of identification of weak learning processes or styles that is key in developing an appropriate remediation program. In the first part of this research, it was found that the prediction of reading ability based on CAS was significant. This implies that remediation of weaker processes as defined by CAS would be most successful in improving reading ability. Relative to normative data, this sample was weakest in terms of successive processing. However, this sample also tended to be weak across all other CAS subtests relative to a standardization sample. Thus, if remediation of weak cognitive or learning styles is to be sought, the evidence thus far suggests that providing remediation for all aspects of the PASS model could be beneficial for native children. This is what Part B of the research attempted to determine.

Vygotsky's contribution. The fourth and final root of the PREP program comes from the influential work of Vygotsky (1962; 1978); more specifically, the notion that learning is a collaborative process and that accelerated learning is possible. Some of the more key concepts that have implications for remediation include the notions of internalization, mediation, and zone of proximal development.

The notion of internalization states simply that children learn through collaboration with others. As Sutton (1988), in paraphrasing Vygotsky, says, "what a child can do in cooperation today, tomorrow he will be able to do on his own" (p. 108). When children are given instruction, whatever the source, they eventually have to make that instruction their own. In other words, they must know it, be familiar with it and realize its meaning. Such internalization of instruction is often accomplished through such things as internalized speech (Das & Conway, 1992). The point of interest for remediation is the quality of internalization not how much internalization has taken place following instruction (Naglieri, Das & Kirby, 1994).

What is the key ingredient for high quality internalization? The answer is reflection. For without reflection, it would be difficult to achieve transfer of learning. Therefore, any remedial program would be better served to incorporate some method or means of eliciting reflection. In this regard think-aloud protocols appear at first glance to be most appropriate. However, the process of thinking aloud must be encouraged in a way that learning is inductive rather than deductive. Most metacognitive programs tend to use the latter method of instruction, i.e., deductive. In deductive strategy training, students are given a principle or strategy that they have not produced themselves, and have not necessarily internalized.

For PREP, the program developers, in accordance with Vygotskian notions of internalization, felt that internalization is best achieved spontaneously and inductively (Das, et al., 1994). They stress that this does not preclude the instructor from assisting the student by guiding the experiences they encounter and helping them generalize their experience. Rather, the strategy or principle a student needs to use must be used with insight and understanding. For the PREP program, the creation of more global-process training exercises were designed to allow the student to internalize the strategies.

What role does verbalization play in PREP training? As Das et al. (1994, p. 170) state, "The principle or strategy need not be verbalized in our training—indeed, it cannot be verbalized accurately. Learning is implicit rather than explicit. But the learner achieves a sense of where it should apply." This however, does not preclude the use or encouragement of verbal mediation when using PREP. Indeed, recent research with PREP suggests that active encouragement of verbalization of strategies is a key ingredient in the success of students transferring their skills to reading (Das, et al., 1995).

The concept of mediation is the blending of two factors, the history of the individual's experience and the integration or assimilation (as defined by Piaget 1974) of information. In order for mediation to arise from within an individual, a psychological tool is required. This is provided by internal speech, which is a system of signs or symbols that evolves within a cultural context.

The concept of the Zone of Proximal Development (ZPD) is probably better translated as the zone of nearest development (Sutton, 1988). The idea of ZPD is defined as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Das, et al., 1994, p.164). Strict imitation does not describe ZPD, rather the notion here is that there is a critical "distance" between a child's current understanding and their potential understanding. For instruction, this implies that teaching should be aimed at the boundaries defined by both prior development and future potential (Sutton, 1988).

Also important within the concept of ZPD is socio-cultural context. Das et al. (1994) state that, "The context of learning is provided by the symbiotic relation between personal characteristics and social milieu" (p.165). However, ZPD cannot be measured as it has no baseline. Therefore, what can be measured are cognitive activities in the context of development. Development is the integration of socio-cultural and genetic factors. Thus for individuals who may be retarded in their development, especially in language, "we can regard speech and language deficit not solely an *individual* handicap, but in the social-historical context of the retarded individual. That is why the remedial program must be entrenched in that context, its efficacy cannot depend on teaching the retarded individual to regulate behavior by improving his or her language facility" (Das et al., 1994, p.167; italics theirs).

The question that remains is whether children with learning problems can be taught significant processing skills, such as successive and simultaneous processing, through the processes of mediation and internalization. To date, the research would seem to support an affirmative answer to this question. The next question is whether these processing skills can result in the transfer of learning to specific skills such as reading? Again the research seems to say yes. That is, there have been numerous studies which support the claim that the PREP program is successful in improving successive, simultaneous, planning and attention skills in addition to decoding and comprehension skills (Brailsford, 1981; Brailsford, Snart & Das, 1984; Carlson & Das, 1992; Das et al., 1995; Krywaniuk, 1974; Krywaniuk & Das, 1976; Molina, et al., 1997; Papadopoulos, & Parrila, 1998a). Each of these studies will be examined in greater detail in a later section.

Perspectives on transfer. The ultimate goal of any remedial program is the successful transfer of skills outside of the experimental environment. In other words, the goal of remediation is the generalization of skills to the classroom and beyond as discussed by Das and Conway (1992). In the case of PREP, we are interested in the transfer of reading skills. The first question that must be asked is whether there is a difference between learning and transfer? Clearly, all learning requires some transfer of skills up to a point. However as Salomon & Perkins (1989, p.115) point out, "when learning something leads to a later performance we identify as more or less the same, in a context that is more or less the same, we do not call this transfer, we just call it learning." Thus, these authors distinguish between such things as rote learning and true transfer. Now the questions that remain are how do we achieve transfer and what kind of learning are we targeting for transfer?

In answering the first part of the question, Brown and Campione (1986) suggest that when principles are the target of transfer they should be based on inductive inferencing arising out of children's experience with a task rather than on the explicit teaching of principles. They further recommend, in the tradition of Vygotsky, that learning should take place in collaboration with peers and experts. So far, these recommendations are in accordance with those espoused within PREP. However, it still does not describe the factors necessary to achieve transfer.

While the explicit teaching of principles may indeed lead to improvement on context-similar skills, they may not extend outside of the context in which they were taught. This is the problem of "low road" transfer over "high road" transfer as described by Salomon and Perkins (1989). The low road of transfer primarily reflects extended practice where distance of transfer depends on the amount of practice and how many contexts in which it's practiced. High road transfer, on the other hand, depends more on mindful abstractions of knowledge from a context. As the authors state, "Abstraction thus involves both decontextualization and re-representation of the decontextualized information in a new, more general form, subsuming other cases. Abstractions, therefore, have the form of a rule, principle, label, schematic pattern, prototype, or category" (p.125). Abstraction is accomplished by forward anticipatory reflections as well as backward inferencing. Most cognitive strategy training desires this "high road" transfer or "far transfer", as it is referred to by Das et al. (1994). To promote far transfer, one must find ways to encourage reflection and abstraction.

To accomplish reflection and abstraction, the PREP program endorses a collaborative learning environment where learning can occur in a flexible context so that inductive inference of principles can occur. As mentioned previously, the principle or strategy need not be verbalized with the PREP program, as learning that is implicit is seen as more effective than explicit learning (Das, 2000).

Research with the PASS Remedial Education Program (PREP)

A more detailed description of each of the separate tasks involved in PREP is found in Chapter 8. This section will include a more general description of PREP followed by an examination of the research performed with the PREP program. The focus of the present review will be on studies with students who are underachieving or have a specific reading disability rather than mentally handicapped individuals. For a description of the latter research, the reader is referred to Das, et al. (1994).

PREP was constructed in order to help students learn planning skills, successive and simultaneous processing skills, while at the same time promoting selective attention. These skills are taught inductively with more global training tasks and then "bridged" to the more specific tasks of reading. Research with versions of PREP date back as far as 1974 when Krywaniuk administered an early version of PREP to a sample from the same native community as was used for the present study.

Krywaniuk's initial study (1974; Krywaniuk & Das, 1976) used 11 training tasks that emphasized successive more than simultaneous processing. These tasks did not include any bridging tasks. That is, they were context free of any academic subject matter. All of his subjects were underachieving Grade 3 and 4 students selected from the same population as the present study. Results showed improvement in the group that received training in tasks similar to those used in the PREP program. Improvements were found in terms of serial learning, visual short-term memory, and the Schonell Word Recognition Test. While this initial study demonstrated strong transfer to both cognitive measures and word recognition, the relative absence of content-specific remedial materials leads one to question whether even greater transfer might not have been possible if specific efforts were made to bridge the learning to academic materials.

Even stronger evidence of the ability to transfer the learning of successive and simultaneous processing skills to reading can be found in a study by Brailsford, et al. (1984). They administered a remedial program to two groups of learning disabled children (N=12 for each group) with either cognitive strategy training or remedial reading. Cognitive strategy training was performed in groups of two children who were instructed in successive and simultaneous processing skills and encouraged to verbalize their strategies. They found that both groups improved over time on successive and simultaneous tasks in addition to reading comprehension scores. However, the cognitive strategy-training group had significantly greater improvement than the remedial group on four of the cognitive tests including Memory for Designs, Serial Recall, Free Recall, and Digit Span Forwards. Greater improvement on instructional reading levels on the Stanford Reading inventory was also found for the cognitive strategy-training group. The authors conclude that "the remediation program taught the child to use active strategies for the organization, coding, memorization, and retrieval of information, and that these cognitive strategies are necessary in the reconstruction of meaning from print." (p.290). One limitation of the above study was that they also failed to utilize reading specific tasks with the more global strategy training tasks. Also they failed to utilize a simple measure of word recognition, vocabulary, or pseudoword reading. Therefore, we do not know whether the cognitive strategy training would have had an effect on these skills. For the purposes of the present study, measures of individual word reading, vocabulary, in addition to reading comprehension measures were included.

It was not until Carlson and Das' (1992) study with "Chapter 1" children in California, that the present version of PREP was finalized. They conducted two separate studies, both times their sample consisted of children assigned to Chapter 1 programs. Assignment to Chapter 1 was based on low parental income, low SAT scores and teacher recommendation. All children were generally underachieving. The first study had 22 fourth Grade children in a remediation group and 15 in a comparison group. The second study, which was a replication and extension of the first study, had 41 fourth Grade children in the remediation group and 37 in the comparison group. The remediation group received the PREP program with both global and bridging tasks in addition to regular Chapter 1 instruction, while the comparison group received only Chapter 1 instruction. They found that the PREP group, in both studies, made significantly more gains on both word identification and word attack than the comparison group. In fact, analysis of reading scores suggested that the PREP group had accelerated their performance on these tasks. In many ways, the sample of native children chosen for the present study is very similar to the sample of Chapter 1 children. At the very least Chapter 1 children and the present sample of native children are similar in terms of level of achievement. The present study utilized many of the same tasks and procedures as used by Carlson and Das (1992) in order to replicate their finding. However, the reading measures for the present study differed from Carlson and Das. The present study used a group reading measure while Carlson & Das used individual word reading and word attack measures.

A more recent study by Das et al. (1995) examined the efficacy of PREP with 20 children in a remediation group and a control group of 31 children. They subsequently split the control group into 2 groups with 18 who received the global training of PREP alone, and 13 students who received the bridging training alone. They found that the remediation group that combined both the global and bridging tasks of the PREP program made significantly better gains in word identification and word attack than a no treatment control group. They note that this result is especially robust as the control group was enrolled in a special education classroom and mainly received literacy and phonics based intervention through direct instruction. They also note that the group that received global training alone made only slight gains in terms of word attack but not word identification while no gains were found in the group who received the bridging training alone. In terms of improvement on cognitive tasks, the PREP group that received both global and bridging tasks only showed significantly greater improvement than controls in terms of Speech Rate and Planned Connections. The authors suggested that they had too many testers, which may have resulted in a lack of standardized testing procedures and led to fewer improvements in cognitive skill. They suggested that future research exploring the efficacy of PREP with younger at-risk readers would be the next step.

The PREP program has also been tested cross-culturally on a Spanish sample of 36 nine and ten year old children (Molina et al., 1997). They found that a group who received PREP, with both global and bridging tasks, made significantly greater gains on cognitive tasks, oral and silent reading, spelling and comprehension, than a control group and a group who received only 7.5 hours of bridging training only. This study seemed to replicate the finding of Das et al. study (1995) with a Canadian sample. This result shows the efficacy of PREP cross-culturally.

Papadopoulos and Parrila (1998a, 1998b) conducted the most recent research utilizing PREP. They conducted a study with children identified as at-risk for reading difficulties in kindergarten. They compared the effectiveness of PREP over a "meaning-based" language enrichment program. Sixty-one Grade 1 children were administered PREP while 164 children received the meaning-based program. They found that the PREP group made significantly greater gains in Word Attack and Word Identification scores. They also found that there were three clusters of children with early reading difficulties. The first cluster consisted of children who performed poorly on cognitive, phonological tasks in addition to reading difficulties. This group is often referred to "garden variety" poor readers. The second cluster of poor readers displayed high overall performance even on phonological coding tasks. They hypothesize that this group may have experienced reading difficulties due to low motivation, poor literacy home environments, or a "visual" deficit. The final cluster they labeled as "true dyslexics". This cluster performed adequately on planning, attention, and simultaneous processing tasks but not so on successive processing and phonological tasks.

A recent study on the effectiveness of PREP was performed by Martinussen, Kirby and Das (1998) with at-risk kindergarten children. They examined the effectiveness of a training program that combined successive processing training and phonological awareness combined. Comparing this program to a meaning-based group and a control group they found that students who received successive-phonological training combined led to higher scores on a phonological analysis task.

A further example of the efficacy of PREP is found in a study by the same authors who examined difficult to remediate second Graders (Papadopoulos & Parrila, 1998b). This study was a follow-up to the above study where students who continued to have difficulties in reading, despite over two years of formal remediation, were offered PREP. They showed that a majority of the difficult to remediate children, after receiving additional help with PREP, made significantly greater gains in their Word Attack skills but not in terms of individual word reading, compared to average children and never-remediated children. They conclude that, "although cognitive remediation is an effective way to ameliorate the reading difficulties of an at-risk population, it is not a panacea" (p.5).

In summary, the research to date on the effectiveness of PREP seems to show that it is effective in improving both the cognitive skills necessary for reading as well as reading skills. It would seem that the greatest improvements have been consistently found on tasks that require the ability to decode words phonetically (i.e., Word Attack). Improvements in Word Identification and reading comprehension tasks have also been reported but less consistently. PREP has been found to be effective cross-culturally, with economically disadvantaged children (e.g. Chapter 1 children), and with difficult to remediate children with reading problems. Despite this strong evidence, PREP has not proven to be a panacea. In addition, the present version of PREP has never been tested on Canadian native children.

Conclusions

Clearly, the research has pointed repeatedly to the importance of phonological skills in reading. However, we also have evidence that phonological skills, while necessary, may not be sufficient for the development of reading. A review of different models of reading acquisition finds support for several models. However, the support is inconsistent and contradictory at times. In addition, most approaches to reading acquisition tend to be bottom up in nature. In contrast, Das, et al. (1994) have proposed a top-down model which holds that there are underlying cognitive processes that mediate the development of any cognitive skill, such as reading.

In reviewing the literature on the various approaches to remediation, we can find many studies that report improvement in various reading skills or sub-skills following their program. However, Reading Recovery programs have been widely criticized for showing a lack of controls, generalizability of results, and for the lack of inclusion of phonological instruction. Metalinguistic or cognitive strategy approaches to remediation have also not fared well under scrutiny, especially with less skilled or younger readers. It appears that these approaches have their greatest utility in improving reading comprehension with readers who have adequate individual word reading skills to begin with. Finally, phonological approaches to remediation have generally shown positive results. However, several researchers agree that phonological approaches to reading are necessary but not sufficient to improve reading skill.

What all of these approaches fail to address is the possibility that there are underlying cognitive processes that mediate the acquisition of skills necessary for reading ability to develop.

PREP, on the other hand, takes into account the presence of higher-order cognitive processes and is based on a sound theoretical background and has a strongly rooted conceptualization. PREP has also shown consistently positive results thus far in the research. Despite this, the present version of PREP has never been tested for its efficacy with Canadian natives, a culturally unique group. This was the impetus for Part B of this research, i.e., the testing of PREP.

Hypotheses

There are five primary hypotheses for this portion of the research:

1. There will be a significant improvement in CAS scores following the administration of PREP.
2. There will be a significant improvement in reading scores, as measured by Stanford Diagnostic Reading Tests and an informal Word Probe, over time following the administration of PREP.
3. There will be a significant Time by Group interaction effect for CAS variables. In other words, students who receive PREP in addition to regular classroom instruction will have statistically greater gains in their CAS scores than a group who receives regular classroom instruction alone
4. There will be a significant Time by Group interaction effect for SDRT and Word Probe variables. In other words, students who receive PREP in addition to regular classroom instruction will have statistically greater gains in their reading scores than a group who receives regular classroom instruction alone.
5. Scores on selected CAS subtests at Time 1 can be used to predict the variability within specific reading scores after the passage of time and the administration of PREP. More specifically, it is expected that simultaneous tasks will have significant predictive ability for reading comprehension tasks and that successive tasks will have significant predictive ability for phonetic and individual word reading tasks.

CHAPTER 8

Methods & Procedures

The Sample

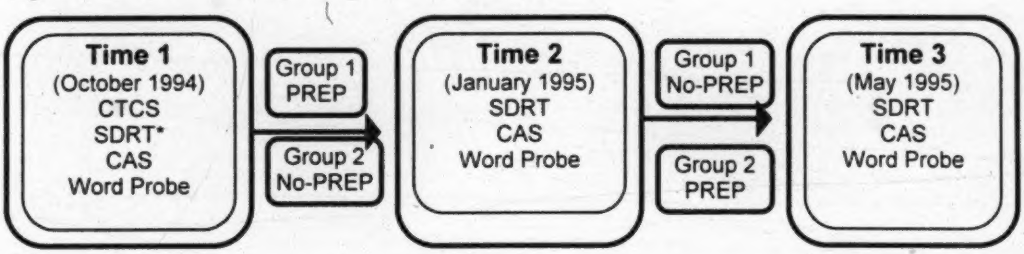
The participants and setting for this part of the research were selected from the same pool of subjects used in Part A. Two separate groups of 14 children each (Total N=28) were chosen for the remedial portion of the research out of the original 52 subjects used in Part A. Each group was matched for reading comprehension levels as measured by the SDRT at the start of the program as well as for gender and age. Closer examination of the data using t-tests revealed that the two groups did not differ significantly from one another on any of the SDRT measures at pretest. One subject from Group 1 had to be dropped from the study as the parent rescinded their consent. This yielded a sample size of 27 for final analysis. Group 1 consisted of 8 boys and 5 girls with a mean age of 107 months (8 years 11 months) while Group 2 consisted of 6 boys and 8 girls with a mean age also of 107 months (8 years 11 months).

Subjects were selected according to the following criteria. First, based on SDRT reading comprehension scores, subjects were rank ordered. From this rank ordering, an equal number of subjects were selected from the top and bottom of the distribution until 28 children had been selected. These children were then divided into two groups to roughly match according to ability level, age, and gender as previously mentioned. Only those children whose parents had signed consent forms or equivalent were included in the remediation phase.

Research Design

As these children were received from the first phase of the research, all of them had received the same psychometric measures as described in Chapter 3 prior to the remediation phase. A control wait-list design was used to examine the effectiveness of the remedial program chosen for this study (see Chapter 6 for description and rationale for the remedial program). The following flow chart will illustrate the design, timelines, and measures used for this portion of the study (See Figure 8.1).

Figure 8.1 Control Wait-List Design Utilized for Part B



Note: CTCS = Canadian Test of Cognitive Skills; SDRT= Stanford Diagnostic Reading Test; CAS= Cognitive Assessment System; PREP=PASS Reading Enhancement Program; Also note that both Group 1 & 2 were tested at each level of testing.

*SDRT was administered in May of 1994.

The Remedial Program

The remedial program for this phase of the research was specifically designed to help students improve the cognitive skills necessary for reading. The remedial program is based on the same theoretical model as the Cognitive Assessment System. That is, the program has its theoretical roots in the Planning, Attention, Successive and Simultaneous (PASS) theory of intelligence. For this reason the program is referred to as PASS Reading Enhancement Program or PREP for short. The following will describe the actual tasks involved in PREP as well as the remedial process used for this study.

PREP. PREP provides structured tasks that are aimed at developing and improving internalized strategies for successive and simultaneous processes. Detailed descriptions of PREP can be found in Das et al.(1994), Das (1993), and Das et al. (1995). The specific goals of PREP are for improvements in successive and simultaneous processing as they apply to reading skills. Das et al. (1994) have referred to improvements as reflected by the corresponding tasks of the CAS as "far transfer" and improvements in reading, spelling, and comprehension as "very far transfer" (p.173). The present research was designed to test PREP's success in both far transfer and very far transfer as reflected in the assessment instruments used for this study. Far transfer would be reflected by significant improvement in the CAS subtests and very far transfer by improvements in SDRT and Word Probe scores.

Originally designed with 10 tasks (6 successive and 4 simultaneous), PREP provides two types of training for each task. The *global* training provides children with the opportunity to learn general successive and simultaneous processing strategies. The emphasis is on helping children to internalize these strategies in their own way in order to maximize generalization and facilitate transfer. In the tradition of Vygotsky, verbal mediation is the vehicle used to accomplish the internalization of global strategies (Das, 1992). The second type of tasks is *bridging* tasks. Bridging tasks provide training for applying the global processing strategies to the specific academic skills of reading. As such, the tasks contain procedures such as rehearsal, categorization, monitoring of performance, prediction, revision of prediction, sounding and sound blending, etc. Both global and bridging tasks are further subdivided into three levels of difficulty.

For the present research, only 8 of the original 10 tasks were utilized. These tasks were chosen on the basis of recommendations from remedial teachers who have administered the PREP program in the past. A person trained in the use of PREP administered the remedial program. The remedial program requires 15 one-hour sessions to be completed. These sessions were run with 2 children at a time with sessions being run twice per week. The following is a brief description of each remedial task used in this study:

Transportation Global. In this task, the students were shown a strip of pictures of different vehicles. After they looked at the full strip, and then at each picture in its place on the matrix individually, the pictures were covered. Students were then asked to reproduce the order with individual pictures on a blank matrix. The correct pictures were mixed together with five distracters. Level 1 contained six items with four pictures per item. Level 2 contained six items, three with four pictures and three with six pictures per item. Level 3 contained six items with six pictures for each. Patterns change from simple to more complex, with each type of vehicle and color creating the pattern.

Transportation Bridging I. In this task, the students were shown a word in a straight-line matrix. After they saw each letter individually in its matrix position, the word was covered and the students were asked to build the word using individual letters. The letters provided included the correct ones as well as five distracters. The students were then asked to read the word. As they were working in pairs, subjects took turns reading the words. The subject who did not read the word was asked to help verify, in a collaborative non-pressured way, whether his/her partner had read the word correctly. The verification process was done so that both students could participate in any one remedial task, thus ensuring better attention and participation.

Transportation Bridging II. In this task, a series of cards with individual words was placed in front of the students. Related words were arranged in alternating or more complex patterns. The students were helped to read the words when necessary and asked to repeat them a number of times. After the words were removed, the students repeated them in order. At Level 1, four words were presented at a time, increasing to a maximum of eight at the end of Level 3. The students looked at the word cards in order following each item and picked out the related pairs. Students were then asked to discuss the pattern used.

Joining Shapes – Global. In this task, the students used a printed arrangement of shapes: rows of triangles, squares and hexagons alternating with rows of circles. They were given one main rule to follow. That is, they were told that straight lines connecting shapes must always pass through a circle. Second, they were asked to listen to directions about how to join specific shapes but always following the first rule. Third they were required to draw lines connecting the shapes as instructed. For example, the examiner may instruct the child to join a triangle to a square. The child would then draw a line starting from the triangle, going through a circle and ending on the square.

Joining Shapes – Bridging. In this task, which parallels the global task and looks much like a word-search puzzle, the students were asked to follow rules similar to those for the global task. However, for this task they were asked to join letters diagonally in sequence to form words. Once they drew the lines they were asked to read the word.

Window Sequencing – Global. In this task, a series of colored circles and squares were shown to the students, one at a time, through a window arrangement. Using the required shapes with no distracters, the students then reproduced the sequence. Level 1 has only one color, Level 2 only one shape, and Level 3 has variation in both color and shape.

Window Sequencing – Bridging. The identical format was used for this task, with students seeing the letters of a word through the window apparatus. They then had to reproduce the word with individual letters and read the word.

Connecting Letters – Global. In this task, five pairs of letters were aligned horizontally on opposite sides of the page. A meandering line joins a letter from one side of the page to a letter on the other side. All five letters on one side are joined, by intertwining lines, to the letters on the other side. The student is required to follow the line with their eyes, identifying what pairs of letters are joined. Level 1 items are joined with colored lines while in Level 3 all lines are black with distracter lines included.

Connecting Letters – Bridging. In this task, the lines joining the letters on either side have letters along the strings that make specific words. The students follow the strings with their eyes, identifying the five words on each sheet. Level 1 items begin with three-letter words and by the end of Level 3 seven-letter words are used. Colored lines join all items in this task.

Related Memory Set – Global. In this task, the outlines of the front of three animals were shown. The students are then shown the back of one of the animals, with an intervening space, and must verbally identify and justify which animal front it matches. At Level 1, animals with stripes and spots are included and by Level 3 many animals that look more similar are included.

Related Memory Set – Bridging. In this task, the students were shown three word beginnings, with one word ending on the other side of the page. The students were asked to verbally identify which beginning fit with the ending letters in order to make a word. They did this without putting the front and back units together. Words were separated into onset, rhyme units, or syllable units.

Matrices – Global. In this task, students were first shown numbers, then letters, in a five cell matrix in the shape of a cross. Each matrix is displayed for 5 seconds as the instructor points to all five cells in a variety of different sequences. The matrix is then covered for 5 seconds. After this, the students were asked to name the sequence in order as the instructor pointed to each cell of a matrix.

Matrices – Bridging. In this task, the matrix cells contained four related words and one unrelated word. The students went through the same process as in the global task of remembering the words in sequence. After the words were identified correctly, the students are asked to identify the related words and explain how the words were related, as well as why the unrelated word did not fit.

Sentence Verification – Global. In this task, the students were shown two, three or four pictures. They were then given a card with two or three sentences relating to one of the pictures. The students were asked to identify which picture matched the text.

Sentence Verification – Bridging. In this task, the students were given one picture with two, three, or four brief sets of text. They were then asked to choose the text that matched the picture context.

Tracking – Global. For this task, a map was presented to the students. The map was displayed about an arm's length from the students and contained identical houses with numbers, identical trees with letters, and a street grid. The students were then given three cards, each containing a different house and the minimal street grid necessary to allow identification of a specific house. The elapsed time required by the students to identify the house number or the tree letter for all three cards was recorded. Three sets of three cards each were presented following this format. The children were then asked to go through a training process involving three different strategies and then repeat the process with the nine original cards. Levels 1 and 2 use the houses and trees, respectively. In Level 3, a map was displayed with only squares containing letters and lines connecting them to the starting point. The cards in Level 3 have the same line and box configuration as in previous levels, but the letters were missing. Students were then asked to identify the letters.

Tracking – Bridging. In this task, a map of West Edmonton Mall was displayed with various symbols (e.g. a bookstores identified by a book symbol). The students were given a story card containing a list of tasks to be accomplished at the mall. They were then required to complete the imaginary tasks by planning and demonstrating the most efficient route by tracing it with their finger on the map. For Level 2, students were shown a line drawing of a playground. The students read a story about three boys/or girls at the playground and had to identify where one of the children was hiding on the basis of various positional cues. Level 3 used the West Edmonton Mall map again with more complex tasks.

The Remediation Process

Research Assistant. A paid research assistant conducted all of the remedial classes. The assistant was not formally trained as a teacher but was given formal instruction in the administration of the PREP program. This particular assistant might be equivalent to a volunteer teacher's aid in terms of her background and experience. Instruction of the PREP program consisted of an instructional video describing the program in general, as well as independent instruction from a person with particular expertise in administering and training others in the administration of PREP. Instruction of the research assistant involved 2 full days of face-to-face instruction as well as being observed by the trainer during administration of the PREP.

Remediation Schedule. All 27 children were required to complete 15 remedial sessions over the course of several weeks. One exception occurred in Group 1 as one student went on extended holidays in December and missed the last three sessions. Due to time constraints, these sessions could not be made up. For Group 1, all of the remaining students completed 15 sessions between October 20 and December 16. Similarly, Group 2 students completed 15 sessions between January 31 and April 13.

As mentioned above, 2 sessions occurred every week, and children attended sessions in pairs that were gender-matched (i.e., girls were always paired with girls and vice versa). Due to the dropout subject in Group 1, one boy received individual instruction for 3 sessions.

Record Keeping. Detailed records of student progress were kept for each student over the course of remediation. These records included daily records of performance on the various tasks and number of items passed for each task. Which level each student completed was also recorded. Anecdotal information, in the form of teacher or student comments regarding the effectiveness of PREP, was also gathered.

Statistical Procedures

Several statistical methods were utilized to examine the effectiveness of PREP. First, descriptive statistics were calculated for each remedial group. Secondly, groups were compared for differences on SDRT, CAS, and Word Probe using t-tests at Time 1. This was done to test whether the groups were properly selected for equality from the outset. To examine the effectiveness of the remedial program, several repeated measures Time by Group ANOVAs were run. However, due to the problems with the Time 1 administration of SDRT subtests, the repeated measures ANOVA only involved changes from Time 2 to Time 3. As there was greater confidence in the reliability of the CAS subtests and Word Probe results, all three Time intervals were included in the repeated measures ANOVA. Due to small sample sizes, MANOVA could not be performed as it violated the assumptions and statistical power would have been too weak. Of primary interest for this phase of the research is the examination of Time X Group interactions. That is, in order for the PREP program to be shown effective there should be group differences depending on when they are tested, either Time 1, Time 2 or Time 3. More specifically, Group 1 should show more relative improvement at Time 2 while the groups should be equal at Time 3 assuming the groups were relatively equal at Time 1. Another possibility is that Group1 may continue to make gains at the same pace as Group 2 such that they maintain their relative difference from Post-test 2 to Post-test 3. Post Hoc comparisons were performed to determine where significant group difference would occur. All inferential statistics were performed utilizing the standardized data from CAS and the SDRT, while raw data were used from the Word Probe.

An alpha level of .05 was chosen for all statistical tests for the purposes of reporting. Where tests had significance levels between .05 and .10, these are reported as non-significant with the p value in parentheses available for the reader.

As there were few significant Interaction effects utilizing ANOVA, the data were further examined in two different ways to explore trends within the data. These secondary analyses consisted of calculating change scores and looking graphically at the change in scores over time based on group. Due to the small statistical power in these tests, these results are placed in Appendix C. These analyses helped to illustrate that there were clearly trends towards improvement for either group on SDRT measures, CAS subtests or the informal Word Probe.

These trends may not have been of sufficient magnitude to elicit a significant result on the ANOVA results due to small sample sizes.

A standard multiple regression analysis was performed on the data to address research hypothesis six. Given the small sample size (N=28), and the number of independent variables (i.e., six CAS subtests), this sort of analysis just meets minimal criteria to ensure validity of the results. That is, for statistical significance the minimum sample size recommended is 5 cases per independent variable (Norman & Streiner, 1994; Tabachnick & Fidell, 1989). However, since there was a greater degree of control over the quality of test administration for this analysis there is greater reliability in these results. There were several assumptions made which guided the choices for how to enter independent variables and in which order. At first, a standard regression with all CAS variables was performed to determine how much cumulative variance could be accounted for in reading scores. Following this, variables were entered based upon the strongest correlations with the dependent variable. The decision to utilize Time 3 SDRT and Word Probe scores was made as Part A had revealed problems inherent in the Time 1 SDRT results. The specific nature of these problems was discussed in detail in Chapter 5. While SDRT change statistics would have been preferred, the choice to use Time 3 SDRT scores was the best alternative

There were also several additional exploratory post-hoc analyses that were conducted on the present data. However, as these analyses do not directly address the research hypotheses, they are also presented in Appendix C.

CHAPTER 9

Results

Pretest Analyses

Group statistics at pretest and the corresponding independent t-test results are presented in Tables 9.1 and 9.2. From this table it can be seen that there were no significant differences between groups at pretest on any of the measures. The only near significant difference between groups (p=.08) occurred for Figure Memory where Group1 outperformed Group2. In terms of general trends, there was a tendency for Group1 to score slightly higher on many of the measures at pretest. More specifically, Group1 scored higher on all CSI measures, simultaneous measures, and only marginally higher on Phonetic Analysis and Auditory Discrimination. As already mentioned, none of these differences were statistically significant.

Table 9.1

Group Statistics and Independent T-test Results at Pretest for the Entire Sample for CTCS

	GROUP	N	M	SD	p *
CSI	1.00	11	80.18	12.29	
	2.00	12	72.75	10.70	.139
Sequences	1.00	11	335.18	75.85	
	2.00	12	296.00	55.33	.177
Analogies	1.00	11	377.64	54.61	
	2.00	12	377.17	45.04	.982
Non Verbal	1.00	11	356.64	57.35	
	2.00	12	336.92	43.48	.368
Memory	1.00	11	503.45	75.54	
	2.00	12	474.25	51.47	.297
Verbal	1.00	11	321.36	84.73	
	2.00	12	278.58	75.63	.217
Total	1.00	11	384.45	43.98	
	2.00	12	356.58	38.53	.123

* two-tailed, unequal variances assumed.

Table 9.2

Group Statistics and Independent T-test Results at Pretest for the Entire Sample for Age, Attendance, and CAS subtests

	GROUP	N	M	SD	p *
Age(months)	1.00	14	107.71	10.67	
	2.00	14	107.57	9.21	.970
93attend	1.00	12	11.33	8.03	
	2.00	13	10.12	8.19	.711
WPROBE1	1.00	14	174.14	169.40	
	2.00	14	159.71	158.60	.818
PLAN1	1.00	14	325.00	70.18	
	2.00	14	293.64	92.67	.323
MAT1	1.00	14	14.64	3.79	
	2.00	14	13.93	3.02	.587
FIGMEM1	1.00	14	10.07	1.94	
	2.00	14	8.43	2.68	.076
EXATTN1	1.00	14	170.14	50.47	
	2.00	14	166.71	17.90	.814
EATNINT1	1.00	14	82.29	22.24	
	2.00	14	85.29	16.45	.689
WSER1	1.00	14	9.86	2.93	
	2.00	14	9.93	3.17	.951
SPRT1	1.00	14	144.21	39.45	
	2.00	14	129.07	26.54	.246
ADSS	1.00	14	563.00	74.16	
	2.00	14	550.57	68.27	.648
PHSS	1.00	14	529.29	63.33	
	2.00	14	527.36	65.17	.937
AVSS	1.00	14	509.14	62.34	
	2.00	14	516.29	28.01	.700
TCSS	1.00	14	483.50	54.65	
	2.00	14	504.07	75.49	.417

* two-tailed, unequal variances assumed.

Presented in Table 9.3 are descriptive statistics by Group at Time 2. From this Table we can see that there was a general trend for Group1 to have the advantage on a majority of measures. It should be noted that these differences were tested for significance in the section that contains the ANOVA models.

Similarly, Table 9.4 contains descriptive statistics for both groups at Time 3. Note that Group 1 tended to maintain its trend of better scores than Group 2 for a majority of measures. The CAS data in table 9.4 are presented in terms of raw data.

Table 9.3

Descriptive Statistics for CAS, SDRT, and Word Probe at Time 2 by Group.

	GROUP	N	M	SD
PLAN2	1.00	13	274.15	81.41
	2.00	14	252.07	71.09
MAT2	1.00	13	16.23	3.27
	2.00	14	15.43	3.59
FIGMEM2	1.00	13	12.15	3.31
	2.00	14	8.86	2.71
EXATTN2	1.00	13	159.77	48.38
	2.00	14	161.86	27.58
WSER2	1.00	13	10.85	3.78
	2.00	14	10.43	2.82
SPRT2	1.00	13	114.23	17.19
	2.00	14	114.79	14.80
WPROBE2	1.00	13	198.46	167.12
	2.00	14	168.50	159.25
ADSS2	1.00	13	514.92	43.20
	2.00	14	513.14	58.23
PHSS2	1.00	13	498.08	32.85
	2.00	14	518.07	40.17
AVSS2	1.00	13	512.54	29.73
	2.00	14	509.14	21.92
TCSS2	1.00	12	455.50	46.51
	2.00	13	474.31	32.67

* two-tailed, unequal variances assumed.

It was decided that some presentation of the data in a normative fashion would provide greater meaning for the reader. Therefore, the present sample was compared to a standardization sample. The standardization group was the same group that was introduced in Part A. To present the data in a normative fashion, each CAS score was translated into a comparable metric to the standardization sample and then standardized. In some cases, this meant that a slightly different measure was used. For example, in the above tables, the planning result is the total time taken for all subtests in seconds. Conversely, the standardization data is based on the total time for subtests 4 through 8 only. In a similar way, expressive attention values in the above tables represent the total time it took for the subject to complete cards 4, 5 and 6. Conversely, the standardization data is based on the time for Card 6 only. Therefore, Card 6 represents the time on the interference portion of the task. Essentially, each raw score was transformed into a deviation score according to the formulas presented in Chapter 3. These transformations always ensured that high scores represented better performance and low scores poorer performance.

Subsequently, deviation scores were transformed to a more familiar metric, namely Standard Scores, with a mean=100 and Standard Deviation=15.

'This was done using the formula:

Formula 9.1: 100+(deviation score*15).

Table 9.4

Descriptive Statistics for CAS, SDRT, and Word Probe for both Groups at Time 3.

	GROUP	N	M	SD
WPROBE3	1.00	14	200.79	160.96
	2.00	14	198.29	165.58
PLAN3	1.00	14	252.57	64.93
	2.00	14	219.00	50.01
MAT3	1.00	14	16.79	4.02
	2.00	14	16.00	2.88
FIGMEM3	1.00	14	12.43	3.50
	2.00	14	10.21	1.72
EXATTN3	1.00	14	165.86	68.95
	2.00	14	158.07	24.83
WSER3	1.00	14	11.36	3.50
	2.00	14	11.14	2.57
SPRT3	1.00	14	107.71	24.64
	2.00	14	110.43	15.27
ADSS3	1.00	13	540.92	54.20
	2.00	14	538.07	63.49
PHSS3	1.00	13	518.54	29.02
	2.00	14	529.79	37.61
AVSS3	1.00	13	531.46	36.66
	2.00	14	529.36	34.48
TCSS3	1.00	12	516.58	51.35
	2.00	14	520.21	61.82

two-tailed, unequal variances assumed.

The culmination of the transformations from Formula 9.1 for Time 1, Time 2 and Time 3 are presented in Tables 9.5, 9.6 and 9.7 respectively.

Table 9.5

Standardized [a] Descriptive Statistics for CAS Measures by Group at Pretest

	GROUP	N	M	SD
PLAN1IQ	1.00	14	91.46	12.27
	2.00	14	96.81	13.97
MAT1IQ	1.00	14	94.00	14.29
	2.00	14	91.42	13.14
FIG1IQ	1.00	14	97.67	7.93
	2.00	14	91.77	11.08
WSER1IQ	1.00	14	93.85	13.94
	2.00	14	93.37	13.95
SPRT1IQ	1.00	14	80.70	21.34
	2.00	14	89.84	14.23
EA1_IQ	1.00	14	94.19	17.91
	2.00	14	89.69	16.25

[a] Mean=100, SD=15; * two-tailed; unequal variances assumed

Table 9.6

Standardized [a] Descriptive Statistics for CAS Measures by Group at Time 2

	GROUP	N	M	SD
PLAN2IQ	1.00	13	96.83	15.67
	2.00	14	101.21	14.59
MAT2IQ	1.00	13	96.53	11.45
	2.00	14	94.36	9.75
FIG2IQ	1.00	13	104.07	11.81
	2.00	14	91.89	10.13
EA2_IQ	1.00	13	92.50	19.50
	2.00	14	90.42	19.53
WSER2IQ	1.00	13	96.56	16.46
	2.00	14	95.10	11.79
SPRT2IQ	1.00	13	96.86	10.83
	2.00	14	97.20	7.48

[a] Mean=100, SD=15; * two-tailed; unequal variances assumed

Table 9.7
Standardized[a] Descriptive Statistics for CAS Measures by Group at Time 3

	GROUP	N	M	SD
PLAN3IQ	1.00	14	99.31	12.86
	2.00	14	106.36	6.38
MAT3IQ	1.00	14	97.21	11.00
	2.00	14	95.53	9.36
FIG3IQ	1.00	14	102.75	11.85
	2.00	14	95.97	7.20
EA3_IQ	1.00	14	87.66	29.25
	2.00	14	89.25	14.41
WSER3IQ	1.00	14	98.55	15.03
	2.00	14	98.22	10.86
SPRT3IQ	1.00	14	99.60	13.87
	2.00	14	98.46	7.19

[a] Mean=100, SD=15; * two-tailed; unequal variances assumed

CAS and Word Probe ANOVA Results

The data from Time1, Time 2 and Time 3 were all analyzed for Group, Time, and interaction effects using several repeated measures ANOVAs. The main finding of interest with these analyses was whether there would be an interaction effect between Group and Time. An interaction effect would show that PREP had a variable effect on each Group. The ANOVA utilized a two (Group) by three (TIME) within subjects design with CAS subtests and Word Probe used as a separate dependent variables. This resulted in 7 separate ANOVA's.

Results are presented in the following order; CAS subtests, Word Probe, and lastly SDRT subtests. Table 9.8 shows the within subjects results of the repeated measures ANOVAs with each CAS measure and Word Probe used as the dependent variable. In terms of Time effects, there were significant results ($p<.05$) for all variables except Expressive Attention. In each case, a significant Time effect consisted of improved scores over time. In terms of interaction effects (i.e., Time * Group), the results were non-significant for all CAS variables.

Table 9.8

Results of Repeated Measures TIME by GROUP ANOVAs with CAS Measures and Word Probe as the Dependent Variables.[a]

Dependent Variables	Source	Type III Sum of Squares	df	Mean Square	F	p
Planned Connections	TIME	72909.20	2	36454.60	19.689	.000
	TIME * Group	140.66	2	70.33	.038	.963
	Error (TIME)	92576.58	50	1851.53		
Expressive Attention	TIME	661.80	2	330.90	.740	.482
	TIME*GROUP	84.32	2	42.16	.094	.910
	Error (TIME)	22346.33	50	446.93		
Speech Rate	TIME	9592.85	2	4796.47	25.086	.000
	TIME * GROUP	740.11	2	370.06	1.935	.155
	Error (TIME)	9559.86	50	191.20		
Word Series	TIME	399.72	2	199.86	6.383	.003
	TIME * GROUP	6.96	2	3.48	.111	.895
	Error (TIME)	1565.45	50	31.31		
Figure Memory	TIME	82.40	2	41.20	9.841	.000
	TIME * GROUP	11.93	2	5.96	1.425	.250
	Error (TIME)	209.31	50	4.19		
Matrices	TIME	65.33	2	32.67	4.203	.021
	TIME * GROUP	.15	2	0.07	.010	.991
	Error (TIME)	388.57	50	7.77		
Word Probe	TIME	12791.529	2	6395.764	15.867	.000
	TIME* GROUP	1913.455	2	956.727	2.373	.104
	Error (TIME)	20154.817	50	403.096		

a Design: Intercept+GROUP Within Subjects Design: TIME

Between Subject effects, or Group differences, for each CAS variable and Word Probe were also analyzed. With the exception of Figure Memory (F(1, 25)=11.85, p=.002), there were no significant between subjects effects, for any of the CAS subtests. For Figure Memory there was a significant difference, across all testing times, between Group1 and Group2, in favor of Group1. Recall that the t-test results for Figure Memory were near significant at pretest (See

Table 9.2) where Group1 had a slight advantage. At Time 2, a t-test revealed that Group 1 had a significantly higher score on Figure Memory than Group 1 (p=.01).

CAS Change Statistics

In order to examine the effectiveness of PREP for improving scores on CAS, a change statistic was calculated. This statistic was calculated by subtracting initial performance on each CAS variable from their performance at PostTest1 and PostTest2 respectively. That is, the formulas used to determine the change in CAS scores were:

Formula 9.2: Time 3 Score – Time 1 Score
Formula 9.3 Time 2 Score – Time 1 Score
Formula 9.4 Time 3 Score – Time 2 Score

In this way, positive scores would represent improvement over time while negative scores would represent poorer performance over time. Separate change scores were calculated for each CAS variable and for each individual using standardized scores. Descriptive statistics for these manipulations for each group are presented in Table 9.9.

From the Table 9.9 we can see that, on the whole, there were positive changes in scores on CAS variables over time and both groups were roughly equivalent in terms of the overall gain in score from time to time. Some exceptions included the Speech Rate Test from Time 3 to Time 1 where Group1 made greater gains than Group2. In order to test whether these differences between groups were significant, the above statistics were subjected to independent samples t-tests. Results were non-significant between groups for all CAS variables (p>.10) with the exception of Speech Rate from Time1 to Time3 (t=2.365, p=0.02) and a near significant difference for Figure Memory from Time1 to Time2 (t=1.762, p=0.09). As can be seen from Table 9.9, for Speech Rate, Group 1 improved by over 18.9 standardized points from Time1 to Time3, while Group2 only improved by 8.6 points for the same time period. Similarly, for Figure Memory from Time1 to Time2, Group1 improved as a group by more than 7 standardized points while Group2 had only negligible improvement for the same time period. Also, with the exception of Expressive Attention, Group1 always showed greater gain from Time 1 to Time 2 compared to Group2. As Group1 received PREP over this time period while Group2 did not, these results provide some evidence that PREP may have had a positive and differential effect for some of the CAS variables.

Table 9.9

Descriptive Statistics for Changes in Standardized CAS Scores over Time Presented by Group

CAS Variable	GROUP	N	M	SD
	Change Scores from Time 1 to Time 3			
Matrices	1.00	14	3.21	12.28
	2.00	14	4.11	12.28
Figure Memory	1.00	14	5.08	15.51
	2.00	14	4.20	10.92
Speech Rate	1.00	14	18.90	10.23
	2.00	14	8.61	12.66
Word Series	1.00	14	4.70	9.27
	2.00	14	4.85	6.82
Planned Connections	1.00	14	7.86	12.83
	2.00	14	9.55	10.75
Expressive Attention	1.00	14	-6.53	18.95
	2.00	14	-.43	18.75
	Change Scores from Time 2 to Time 3			
Matrices	1.00	13	1.11	13.72
	2.00	14	1.17	12.30
Figure Memory	1.00	13	.93	9.55
	2.00	14	4.08	10.42
Speech Rate	1.00	13	5.35	3.65
	2.00	14	1.25	8.60
Word Series	1.00	13	2.97	8.47
	2.00	14	3.12	7.48
Planned Connections	1.00	13	2.76	11.68
	2.00	14	5.15	11.48
Expressive Attention	1.00	13	-1.96	17.76
	2.00	14	-1.17	16.03
	Change Scores from Time 1 to Time 2			
Matrices	1.00	13	3.01	11.57
	2.00	14	2.94	15.75
Figure Memory	1.00	13	7.68	10.06
	2.00	14	.12	12.06
Speech Rate	1.00	13	11.88	9.26
	2.00	14	7.36	16.63
Word Series	1.00	13	3.05	7.91
	2.00	14	1.73	8.54
Planned Connections	1.00	13	5.25	11.94
	2.00	14	4.40	11.57
Expressive Attention	1.00	13	-2.04	12.24
	2.00	14	.73	17.89
Column Averages	1.00	14	5.54	6.51
	2.00	14	5.15	5.15

Despite the generally positive changes in CAS scores over time, what the above results do not show is how individuals performed over time. That is, while there were group changes that were positive there were still individuals who either showed no change or even showed decreases over time. Table 9.10 shows the number of individuals who showed zero or negative changes from Time 1 to Time 3 on CAS subtest. This table aptly illustrates how a significant proportion of the entire sample failed to show improvement, despite the passage of time and the administration of PREP. This was most noticeable for Expressive Attention where over half of the subjects failed to show improvement. The Matrices subtest was similar in that 43% of the subjects failed to show improvement.

Table 9.10

Number of children with zero or negative change scores from Time 1 to Time 3 on CAS variables by Group. (N=28)

Group	Matrices	Figure Memory	Speech Rate	Word Series	Planned Connections	Expressive Attention
1	7	3	0	4	4	7
2	5	7	5	5	3	8
Totals	12	10	5	9	7	15
% of Total	43%	36%	18%	32%	25%	53%

Word Probe Change Statistics

Change scores were also calculated for Word Probe scores and these are presented in Table 9.11. Table 9.11 shows clearly that there was improvement over time for each group and that there was a trend in the expected direction for each group to have relatively greater improvement in the number of words they could decode depending on when they received PREP. Also of note was the large standard deviations which in most cases exceeded the means. These indicate wide variability from student to student in terms of how many new words they could successfully decode following PREP. In terms of range over the entire time interval, Group 1 had change scores from –4 to 78. Similarly, Group 2 had change scores ranging from 1 to 168 new words learned. This large variability may have to do with the choice to establish a cutoff.

Table 9.11

Descriptive Statistics for Changes in Word Probe Scores over Time Presented by Group

GROUP	N	M	SD
	Change Scores from Time 1 to Time 2		
1	13	16.23	17.46
2	14	8.79	10.33
	Change Scores from Time 2 to Time 3		
1	13	6.46	8.25
2	14	29.79	43.43
	Change Scores from Time 1 to Time 3		
1	14	26.64	24.02
2	14	38.57	44.2

The above results can be seen more clearly in Figure 9.1 below. When the above figures are subjected to a repeated measures ANOVA the result approached significance (F(2,24)=2.59, p=.09). From this Figure we can see that Group 1, who received PREP from Time 1 to Time 2, improved at a greater rate than Group 2. Conversely, Group 2 improved at a greater rate than Group 1 from Time 2 to Time 3 when they received PREP and Group 1 received only regular classroom instruction. While there is no cross over, the expected trend towards interaction was clearly observed.

Reading ANOVA Results

Presented next are the within subjects ANOVA results with SDRT measures as the Dependent variables (see Table 9.12). Unlike the ANOVA results for CAS subtests, this analysis only included results from Time 2 to Time3 as the administration of Time reading scores was suspect. In terms of Time effects, Table 9.12 shows that there was a significant effect for every reading measure with the exception of Phonetic Analysis. This means that there was a significant improvement in reading scores from Time 2 to Time 3 regardless of group. In terms of interaction effects, there were no significant results for any of the reading measures.

Between subjects effects for the repeated measures ANOVAs with SDRT as dependent variables were all non-significant for all reading measures.

Figure 9.1

Word Probe Raw Scores Over Time and by Group

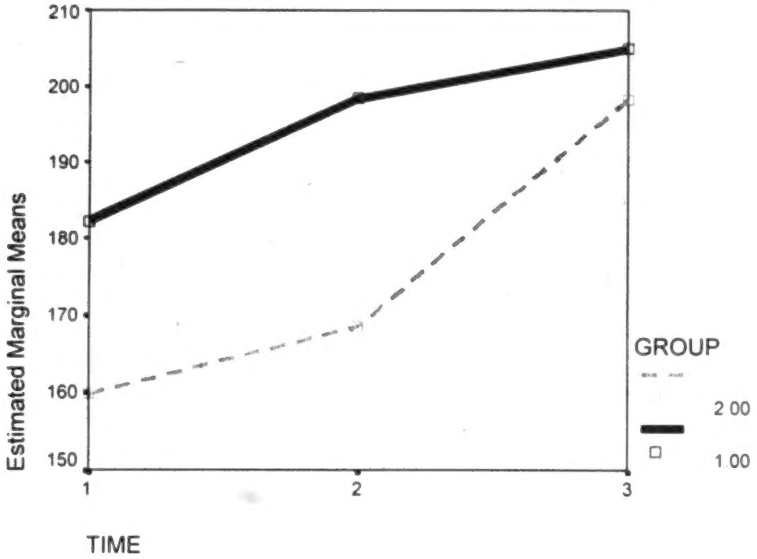


Table 9.12

Results of Repeated Measures Time (2) by Group (2) ANOVAs with Reading Measures as the Dependent Variables.[a]

Dependent Variables	Source	Df	Mean Square	F	Sig.
Auditory Discrimination	TIME	1	8741.80	8.071	.009
	TIME* GROUP	1	3.87	.004	.953
	Error (TIME)	25	1083.18		
Auditory Vocabulary	TIME	1	5162.51	17.06	.000
	TIME* GROUP	1	5.62	.019	.893
	Error (TIME)	25			
Phonetic Analysis	TIME	1	3489.29	4.008	.056
	TIME* GROUP	1	257.88	.296	.591
	Error (TIME)	25	870.48		
Reading Comprehension	TIME	1	35164.23	19.94	.000
	TIME* GROUP	1	409.23	.232	.635
	Error (TIME)	25	1763.61		

a Design: Intercept+GROUP Within Subjects Design: TIME

SDRT Change Statistics from Time 2 to Time 3

In order to more closely examine the changes in SDRT scores over time, change statistics were calculated for SDRT subtests using the same formulas as were used above (namely Formulas 9.2 to 9.4) on SDRT standard scores. However, only scores from Time 2 to Time 3 are included in the analysis for the same reason as specified in the ANOVA section. The results of these calculations for each group are in Table 9.13.

From Table 9.13 from Time2 to Time3, scores showed general improvement on all SDRT subtests. This result was expected as the influence of time, education, and PREP should have resulted in positive gains over this time frame.

Table 9.13

Descriptive Statistics of Changes in SDRT Standard Scores from Time2 to Time3 for both Groups.

SDRT Variables	GROUP	N	M	SD
Auditory Discrimination	1.00	13	26.0000	45.4037
	2.00	14	24.9286	47.5726
Auditory Vocabulary	1.00	13	18.9231	20.2092
	2.00	14	20.2143	28.0554
Phonetic Analysis	1.00	13	20.4615	44.9882
	2.00	14	11.7143	38.4676
Total Comprehension	1.00	11	60.1818	58.7653
	2.00	13	48.4615	59.9063

Regression Analysis

Prior to the regression analysis, correlations were calculated between Time 1 CAS Subtests and Time 3 SDRT and Word Probe scores. As there were a total of 30 correlations calculated, it was decided to present only the significant correlations in Table 9.14. The entire correlation matrix can be found in Appendix C. In looking more closely at the results in Table 9.14, there were three significant findings that involved CAS variables at Time 1 and SDRT variables at Time 3. Given the relative position in time and given that CAS variables are postulated to be higher order factors, these findings may speak directly to the question of predictability. First, Auditory Vocabulary scores at Time 3 were significantly positively correlated with both Word Series (p=.067) and Figure Memory (p=.056) at Time 1. This indicates that those who performed well on the successive task of Word Series and the simultaneous task of Figure Memory, tended to show better performance on Auditory Vocabulary after the administration of PREP and the passage of time. Conversely, as was previously mentioned, Time 1 Expressive Attention scores were significantly negatively correlated with Auditory Vocabulary scores at Time3. Therefore, this suggests that those students, who performed well on successive and simultaneous tasks, but relatively poorly on Expressive Attention, were most likely to show good performance on Auditory Vocabulary after they received PREP.

Table 9.14

Significant Correlations (p<.10) between Time 1 CAS and Time 3 Reading Variables.

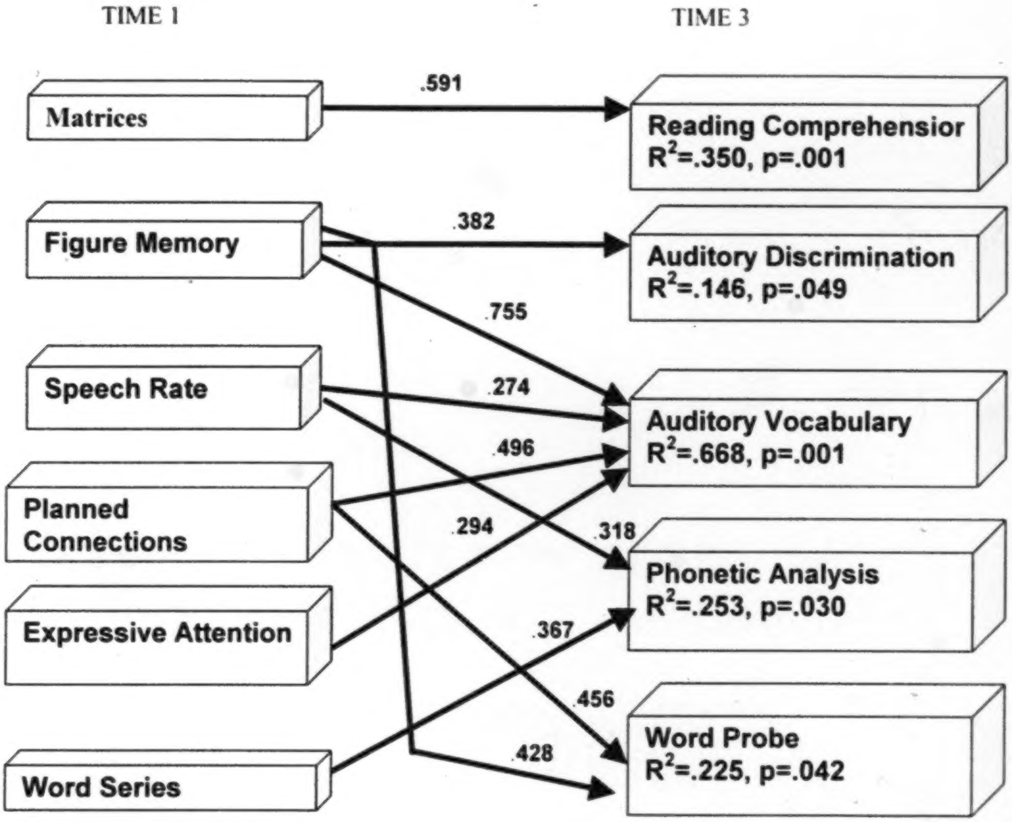
Variable 1 (CAS)	Variable 2 (SDRT)	r	p
Figure Memory Time 1	Auditory Discrimination Time 3	0.382	0.049
Figure Memory Time 1	Auditory Vocabulary Time 3	0.372	0.056
Matrices Time 1	Total Comprehension Time 3	0.591	0.001
Speech Rate Time 1	Phonetic Analysis Time 3	-0.344	0.079
Word Series Time 1	Phonetic Analysis Time 3	0.390	0.044
Word Series Time 1	Auditory Vocabulary Time 3	0.395	0.041

Regression analysis was performed utilizing various combinations CAS subtests as independent variables in order to determine which CAS variable or combination of variables successfully predicted the Time 3 reading scores as measured by SDRT and the informal Word Probe. Presented in Figure 9.2 is a summary diagram illustrating which CAS variable or combination of variables at Time 1 had the best predictability of the various reading scores at Time 3. Arrows drawn indicate which variables contributed significantly to the predictability. Numbers over the arrows represent the standardized Beta coefficients for the regression equation. In all cases, standard multiple regressions were run.

From Figure 9.2, we can see that for some of the reading measures, only a single CAS variable added significantly to the predictability of the model. More specifically, we see two different simultaneous processing tasks, namely Matrices and Figure Memory, contributed significantly to the variance of Reading Comprehension and Auditory Discrimination scores respectively. In fact, Matrices accounted for approximately 35% of the variance in Time 3 Reading Comprehension scores. Conversely, Figure Memory, by itself, accounted for nearly 15% of the variance in Auditory Discrimination scores.

Figure 9.2

Summary of Multiple Regression Analysis with Time 1 CAS scores as Independent Variables and Reading Scores at Time 3 as the Dependent Variable.


TIME 1
TIME 3
Matrices
Figure Memory
Speech Rate
Planned Connections
Expressive Attention
Word Series
.591
.382
.755
.274
.496
.294
.318
.367
.456
.428
Reading Comprehensior
R^2=.350, p=.001
Auditory Discrimination
R^2=.146, p=.049
Auditory Vocabulary
R^2=.668, p=.001
Phonetic Analysis
R^2=.253, p=.030
Word Probe
R^2=.225, p=.042

For Auditory Vocabulary, the number of predictors increased dramatically with 4 CAS tasks independently and significantly accounting for a proportion of variance. More specifically, a standard multiple regression with Figure Memory, Planned Connections, Expressive Attention and Speech Rate as the independent variables, accounted for nearly 67% of the variance in Time 3 Vocabulary scores. This result was highly significant (p=.001).

For Phonetic Analysis, which required subjects to find matching speech sounds, two successive tasks, namely Speech Rate and Word Series, accounted for a significant proportion of the variance. In this case, Word Series had a stronger relationship but Speech Rate did add significantly to the predictability.

Lastly, the informal Word Probe was predicted by a combination of Figure Memory and Planned Connections. These two CAS subtests accounted for 22.5% of the variance in Time 3 Word Probe scores.

Overall Summary of Results

Overall, the present study set out to test the effectiveness of PREP with a native sample of children. The results from the present study demonstrated the following significant findings:

- The groups were roughly equivalent on all tasks at pretest. One possible exception was the difference between Group1 and 2 on Figure Memory which was in favor of Group 1 (p=.076).
- Relative to an age-matched standardization group, this sample of native children scored between 3 and 20 standard points below the norm at Time 1. However, by Time 3, both groups had improved relative to the norm group in terms of standard scores.
- In terms of CAS change scores, from Time 1 to Time 2, both groups generally showed higher standard scores over time. However, Group 1 always improved more that Group 2. Similarly from Time 2 to Time 3, both groups tended to show higher standard scores but the advantage was more often in favor of Group 2. The one exception to this was on Speech Rate where, Group 1 always showed greater positive changes over time. In fact, from Time 1 to Time 3, Group 1 scored 18.9 standardized points higher, which was statistically significant (t=2.365, p=.02). Functionally, this means Group1 went from the borderline range of functioning relative to the norm group to average by Time 3. This represents a significant improvement.
- Expressive Attention was the only task where both groups showed either no change or slightly lower standard scores over the entire interval.
- Despite the generally positive changes for both groups, there were still quite a number of individuals that showed either no change in CAS scores over the interval or scored lower over time. In fact, in some cases (e.g. Expressive Attention) more than half of the subjects showed zero or negative change scores over time.
- The ANOVA results were significant for Time effects using Planned Connections, Word Series, Speech Rate, and Figure Memory as dependent variables. These Time effects consisted of significant improvements from Time 1 to Time 3.
- The ANOVA results were significant for Time effects using Word Probe and all the SDRT subtests as dependent variables. However, the significant Time effect for Word Probe entailed positive changes from Time 1 to Time 3 while for SDRT the Time effect consisted of a significant increase in scores from Time 2 to Time 3.
- There were no significant interaction effects for any of the CAS, Word Probe or SDRT variables. There were however some trends in the data that suggested PREP may have had a

differential and positive effect on the groups. This trend was observed most strongly for the change in Word Probe scores over time as illustrated in Figure 9.1

- It was found that Figure Memory and Word Series scores at Time 1 were significantly positively correlated with Auditory Vocabulary scores at Time 3. Also, two successive tasks, Speech Rate and Word Series at Time 1, were significantly positively correlated with Phonetic Analysis scores at Time 3. Lastly, Matrices at Time 1was the only CAS variable that was significantly correlated with Total Comprehension scores at Time 3.
- The above results provided clues to the regression analysis between Time 1 CAS variables and SDRT scores at Time 3. Regression results are presented succinctly in Figure 9.2 above.

CHAPTER 10

Discussion

Discussion of Descriptive Results

The initial analysis was carried out to determine whether the two groups were roughly equivalent at Time 1. As the t-tests indicated, Group 1 and Group 2 were roughly equivalent on all reading and CAS variables. The only exception to this was a non-significant ($p=.076$) difference between Group 1 and 2 on Figure Memory in favor of Group 1. While non-significant, this implies that Group 1 may have had a slight advantage in terms of simultaneous processing skills prior to the administration of PREP.

It was generally found that the present sample of native children scored significantly below their age peers in a standardization group. While this finding is consistent with other research that has reported that native groups tend to underachieve on standardized tests of reading (Gilliland, 1992; Larose 1991), the magnitude of the deficits in this sample was somewhat unexpected. The significant underachievement of this sample held true for both the SDRT reading results and the CAS results. More specifically, the students chosen for remediation were in Grades 3 and 4. As equal numbers of each Grade were selected, one might expect their overall Grade level of performance to approximate a Grade 3.5 level. In examining the average scaled scores from the SDRT, both groups were performing roughly at a Grade 2 level in terms of Auditory Discrimination skills, Grade 1.5 for Phonetic Analysis, Grade 1.6 for Auditory Vocabulary, and finally Grade 1.4-1.7 for Total Reading Comprehension. This suggests that these students were performing at least 2.0 Grade levels below their current Grade placement and were functionally like beginning readers. Auditory Discrimination was clearly a relative strength for this sample although they still scored below average on this measure.

This result has clear implications for instruction with these students. That is, at Time 1 these students were performing more like beginning readers in both analysis and synthesis skills. In addition, many of these students lacked the basic vocabulary ability to understand even the most basic instruction in Grades 3 and 4. Clearly, some intensive help for these students was called for.

Native Learning Styles

Cognitively, the sample chosen for remediation were clearly performing below the standardization group on all measures. In terms of a standard scale (i.e., mean=100, standard deviation=15) the native sample, as a group, scored between 2.3 to 19 points below the average when compared to a standardization sample for CAS subtests. Thus, this group was low average in terms of their overall cognitive performance as reflected by the CAS. Second, the groups chosen for remediation clearly demonstrated a relative and normative weakness, performing in the low average range, on both of the successive measures (Speech Rate and Word Series). Conversely, the groups scored within the average range on simultaneous measures (Figure Memory and Matrices) as well as Planning and Expressive Attention.

Krywaniuk and Das (1976) also found that a native sample tended to score relatively higher on simultaneous tasks and lower on successive tasks when compared to a random sample of students from a nearby urban center. The present study replicated this finding. There are several possible explanations for this finding which were outlined in Part A. The possibility that natives have a relative strength in simultaneous processing is one explanation. However, it is also possible that this finding suggests a non-verbal strength or a strength for tasks that involve visual analysis.

It has been suggested in the literature that native children may prefer a non-competitive or collaborative learning environment (Swisher & Dale, 1989; Walker et al. 1989; Wauters, Bruce, Black, & Hocker, 1989). Some anecdotal evidence may support this notion for the present sample. That is, it was observed during group tests that many students attempted to assist weaker students during testing. Despite being given instructions on proper test behavior and told that their behavior constituted cheating, some students persisted in helping the student and didn't seem to understand why their behavior was being viewed as problematic. Indeed, the preceding statement itself demonstrates the common North American bias in standardized testing that all work, and especially work done in a testing format, should be independent.

This tendency toward non-competitiveness may also explain the apparent community attitude toward testing in general. As was mentioned in a previous section, the whole concept of school-wide standardized testing had been a foreign concept to this school up to the year prior to this study. According to information provided by the school, the idea of testing was even actively resisted by some community members and teachers, and only agreed to reluctantly.

Discussion of ANOVA results

Time Effects. The first research hypothesis is,

> There will be a significant improvement in CAS scores following the administration of PREP. (p.99)

There were significant Time effects for a majority of CAS subtests (Planning, Word Series, Speech Rate, Figure Memory) for the informal word reading test (Word Probe) and for all of the SDRT subtests (Auditory Discrimination, Auditory Vocabulary, Phonetics, and Comprehension). All results were significant at $p<.01$ level. One near significant result occurred on the Matrices subtest ($p=.051$). Thus, the first hypothesis was confirmed.

For the CAS variables, the significant time effect consisted of both groups showing significant improvements from Time 1 to Time 3. Interestingly there was no significant Time effect from Time 1 to Time 2, not even for Group 1 who received PREP over this time frame. Perhaps the small sample sizes contributed to the lack of significant findings. Conversely, it is also possible that PREP alone was insufficient to lead to a significant increase in CAS scores.

Similarly, research hypothesis two speaks directly to time effects for SDRT subtests. It reads,

> There will be a significant improvement in reading scores, as measured
> by Stanford Diagnostic Reading Tests and an informal Word Probe, over
> time following the administration of PREP. (p.99)

For the SDRT, the significant Time effect consisted of a significant drop in scores from Time 1 to Time 2 for both groups. The negative result from Time 1 to Time 2 for SDRT subtests presents something of a quandary. This result was entirely unexpected and counterintuitive. One possible conclusion for this result is that the SDRT testing at Time 1 must have held a systematic bias that resulted in the over-inflation of test scores. There are several compelling reasons to draw this conclusion. First, one would expect that both groups would, at worst, have the same rate of reading improvement over the three-month interval. Given natural maturation, regression to the mean, and the fact that both groups received regular classroom instruction, one would expect at least mild gains in reading scores over several months of regular classroom instruction. Second, the SDRT results from Time 2 to Time 3 showed clear increases in scores for both groups as expected. The same person, using standardized administration as per the test manual, performed the test administration for Time 2 and Time 3. Conversely, classroom teachers administered Time 1 SDRT results. Subsequently, informal interviews with the teachers and the Special Education Co-ordinator revealed that many teachers did not follow standardized instructions and read some of the items and words out loud for the students, even when the administration manual gave instructions that students were expected to read independently. In addition, some may not have followed the time guidelines and given extra time to complete certain subtests. Lastly, there was some suggestion that some teachers had given explicit instruction in how to complete the type of subtests found on the SDRT, immediately prior to the actual test administration. All of these factors combined would most likely have led to a systematic bias in test administration that would have led to over-inflated scores at Time 1. The above argument may also explain the lack of significant interaction effects for SDRT results.

For the above reasons, a different interpretation of results for Time 1 may be called for. For example, reading comprehension and Auditory Vocabulary at Time 1 may be better interpreted as measures of listening comprehension and receptive vocabulary respectively. This is because many teachers may have read the items out loud to the students rather than requiring their independent reading of items as is specified in the administration manual.

However, for CAS, the same testers performed the administration of subtests on all three occasions. Also, test administration was closely monitored to ensure it was standardized. For this reason, the analyses involving CAS subtests are still be considered valid for interpretation.

Interaction Effects. In terms of interaction effects, research hypotheses three and four both address interaction effects. These hypotheses read,

> There will be a significant Time by Group interaction effect for CAS variables. In other words, students who receive PREP in addition to regular classroom instruction will have statistically greater gains in their CAS scores than a group who receives regular classroom instruction alone.
>
> There will be a significant Time by Group interaction effect for SDRT and Word Probe variables. In other words, students who receive PREP in addition to regular classroom instruction will have statistically greater gains in their reading scores than a group who receives regular classroom instruction alone.

Hypothesis three is akin to the concept of far or high-road transfer while Hypothesis four is similar to very far transfer (Salomon & Perkins, 1989). There were no significant interaction effects found for any of the CAS, Word Probe or SDRT variables. Perhaps the small sample sizes, the significant problems with Time 1 administration of SDRT, and the generally positively skewed distribution of scores influenced this result. Despite these limitations, this finding is in direct contrast to those studies that have reported positive effects for PREP (Brailsford, et al., 1984; Carlson & Das, 1992; Carlson, & Das, 1997; Das et al., 1995; Krywaniuk, 1974; Krywaniuk & Das, 1976; Molina et al., 1997; Papadopoulos & Parrila, 1998a, 1998b). The lack of significant findings forces us to reject hypotheses three and four.

There were, however, trends in the data that suggested that PREP might have helped improve cognitive skills in certain areas and for certain students. More specifically, examination of CAS scores as a function of Group and Time showed the expected interaction trend for Expressive Attention, Speech Rate, Figure Memory, and Word Probe. Unfortunately, none of these trends were significant. Perhaps, the small sample sizes and the inclusion of children of widely varying ability level had some impact on the results. Also, the present study utilized a group reading test that did not include an individual word reading or word attack subtest that was common to many of the studies that reported success. This difference in measure may have been part of the reason for the lack of significant findings.

In examining the change scores over Time we find further evidence that PREP may have had a positive effect in terms of improving cognitive skills. More specifically, from Table 9.9 we see that from Time 1 to Time 2, Group 1 always had a relatively greater increase in CAS scores than Group 2. The only exception to this was Expressive Attention where Group 1's performance actually decreased over time while Group 2 showed only a marginal improvement. What this suggests is that Group1 may have benefited from the additional help PREP provided, even though the advantage for Group 1 was marginal. The CAS subtests where this improvement was greatest was for Speech Rate and for Figure Memory. For Speech Rate, Group 1 improved by 11.8 standardized points while Group 2 by only 7.4 points from Time 1 to Time 2. Similarly for Figure Memory, Group 1 improved by 7.7 points while Group 2 had negligible improvement over the same time period. While the finding for Figure Memory was non- significant ($p=.09$), it is possible that with larger sample sizes a significance level of $p<.05$ may have been reached.

From Time 2 to Time 3, Group 2 received PREP while Group 1 continued with only regular classroom instruction. The original hypothesis was that Group 2 would now increase both their reading ability and their cognitive skills at a greater rate than Group 1. However, one could also argue that Group 1, who now had slightly improved cognitive skills as well as having developed more efficient strategies for approaching reading tasks, would be in a better position to benefit from regular classroom instruction. Therefore, one might hypothesize that the expected rate of improvement in cognitive and reading skills for these two groups would be more equivalent.

In fact, when examining change scores over this time interval we find that rate of improvement was virtually identical for both groups as well as being generally positive. In other words, regular classroom instruction was clearly having a positive effect on all students. Group 1 and Group 2 showed similar improvements in cognitive skills from Time 2 to Time 3. The only exception was Expressive Attention where both groups actually showed decreased performance. What this suggests is that the second hypothesis may be more correct. That is, Group 1, having had the benefit of PREP earlier in the school-year, continue to show improvements that outpaced Group 2.

Discussion of SDRT Change Results

Chapter 5 already contains a discussion regarding the negative change in reading scores from Time 1 to Time 2 and the problematic nature of the Time 1 administration of the SDRT. However, there is reason to have more confidence in Time 2 and Time 3 SDRT results as the same examiner completed the testing and used standardized instructions on both occasions. Therefore, general trends in the data for these time periods will still be discussed. In general, all children showed improvements from Time 2 to Time 3 in SDRT scores and these improvements were statistically significant. There appeared to be no advantage for Group 2 over Group 1, despite the fact that Group2 had just received PREP. However, no conclusions can be drawn from this without reliable Time 1 data. That is, we cannot be certain that these groups were equivalent at Time 1. Another possibility is that Group 1, who had already received PREP, may have continued to improve with only regular classroom instruction.

Correlation and Multiple Regression Discussion

The last question to be examined from the correlational analysis involves how CAS scores at Time 1 would relate to Time 3 SDRT scores. Since there was 7 months between the administration of Time 1 and Time 3, this analysis constituted a longitudinal analysis. As both Groups had received the same degree of remedial and regular classroom instruction the total sample could be analyzed without fear that PREP could have acted as a confounding variable. The real question here was to determine what sorts of cognitive factors at pre-test would help to predict how students would perform on reading measures after the passage of 6 months and with the administration of PREP. The correlational results were presented in Table 9.14 in the previous chapter. In terms of predictability the research hypothesis was,

> Scores on CAS subtests at Time 1 can be used to significantly predict the variability within reading scores after the passage of time and the administration of PREP. More specifically, it is expected that simultaneous tasks will have significant predictive ability for reading comprehension tasks and that successive tasks will have significant predictive ability for phonetic and individual word reading tasks.

Prediction of Auditory Vocabulary Performance. The first interesting finding was that Expressive Attention, Figure Memory and Word Series scores at Time 1 were all significantly correlated with Auditory Vocabulary scores at Time 3. However, Figure Memory and Word Series were positively correlated while Expressive Attention was negatively correlated. The negative correlation with Expressive Attention, at first glance, appears counter-intuitive as it suggests that those who had weaker Expressive Attention skills tended to show relatively greater vocabulary skill after remediation. One might expect that students who had better attention skills and expressive ability prior to remediation would be better able to benefit from remediation. However, the opposite was found. Perhaps this is because this sample, as a group, tended to have very weak Expressive Attention skills overall. One might expect that those who had the weakest attention skills at pretest may have shown the greatest improvement in their Expressive Attention skill over time and, in turn, may have shown increased performance in vocabulary ability.

Overall, the above finding suggests that Figure Memory, Word Series and Expressive Attention ability prior to remediation may have some predictive ability in terms of determining Auditory Vocabulary ability after PREP. Multiple regression analysis, as illustrated in Figure 9.12, showed that Auditory Vocabulary scores at Time 3 were best accounted for by a combination of Figure Memory, Planned Connections, Expressive Attention and Speech Rate. Note how these subtests represent each of the four components of the PASS model. In fact, 67% of the variability in vocabulary skill, after time and remediation, was accounted for by a combination of all the PASS variables.

It could be argued that Auditory Vocabulary is mostly a test of a person's knowledge base. According to the PASS model, knowledge base is derived from the processing of information, which requires all the PASS processes. Thus, the finding that all four processes significantly and independently contributed to the variation in Vocabulary ability adds support to the overall theoretical model (Das, Naglieri, Kirby, 1994).

Prediction of Phonetic Analysis. On the Phonetic Analysis subtest of the SDRT, subjects were given a word with a letter or letters underlined. They were then presented with three words directly beside the key word and asked to identify which word had a similar sound to an underlined portion of the key. This task primarily required the analysis of individual words into their component sounds, which makes this predominantly a successive task.

Correlational and multiple regression analysis generally confirmed the importance of the successive tasks of Word Series and Speech Rate in accounting for the variance of Phonetic Analysis skills over time. A quarter of the variance in Phonetic Analysis skills was accounted for by these successive tasks. If one is to accept that successive processing skills are higher-order skills, and since successive tasks preceded the administration of Phonetic Analysis, we can conclude more firmly that successive processing is an important factor in predicting future reading success, especially in terms of developing phonological skills. This conclusion could be more firmly made with analyses such as path analysis or cross-lagged correlation. Unfortunately, the small sample size precluded these sorts of analysis. This is in direct support of previous studies, which have found that successive tasks reliably predict aspects of phonological coding and word, decoding skills (Das & Mishra, 1991; Das, Mok, & Mishra, 1994). As Kirby, Booth and Das (1996) state, "Successive processing emerges in this and previous studies as an important factor in the development of skilled reading. It is possible that successive processing is ether a prerequisite for phonological coding or a critical component in its application to reading." (p. 454).

Prediction of Auditory Discrimination. Auditory Discrimination is a task that required the students to identify whether two words had similar word sounds at the beginning, middle, or end of the word. In this case, the students did not have to read the individual words but were only required to listen for similarities in word sounds and whether they occurred at the beginning, middle or end. At first glance, one might expect that this task is successive in nature due to the phonological requirement of identifying the serial order of the sound. However, results demonstrated that a simultaneous task, namely Figure Memory, was the only task to show a significant relationship to the Time 3 scores and change scores over time for this task. Perhaps this is because the main task in Auditory Discrimination is looking for similarities in sounds, which is more simultaneous in nature. In some ways, Auditory Discrimination could also be viewed as a verbal working memory task, since the children must keep the words they hear in memory while simultaneously performing a structural analysis of the words for comparison purposes. Das et al. (1994) state that both successive and simultaneous processing are involved in working memory. The finding of a relationship between Auditory Discrimination and Figure Memory may support the notion that simultaneous processing is more strongly related to verbal working memory tasks.

Prediction of Total Comprehension. Only Matrices scores significantly predicted Total Comprehension. That is, Matrices alone accounted for 35% of the variance in Time 3 Comprehension scores. This finding is consistent with past research that has generally found a strong relationship between simultaneous processing and comprehension ability (Das, Cummins, Kirby, & Jarman, 1979; Das, Mensink, & Janzen, 1990; Das et al., 1982; Kirby & Gordon, 1988; Kirby & Williams, 1991; Naglieri & Das, 1988; Naglieri, Prewett, & Bardos, 1989; Parrila & Kirby, 1998). However, the present research also demonstrates that a simultaneous processing task such as Matrices has significant predictive ability longitudinally, even considering the administration of PREP.

This analysis may also be directly comparable to a study by Parrila and Kirby (1998). These authors did a longitudinal analysis on the role of phonological skills, cognitive skills (from the PASS model), and knowledge base in relation to reading (Word Identification and Passage Comprehension from the Woodcock-Johnson). They tested a sample of 95 students at Kindergarten, Grade 1, 2 and 3. Using path analysis they found that Kindergarten successive processing predicts Grade 1 passage comprehension and that Grade 1 planning predicted Grade 2 passage comprehension. Simultaneous processing predicted phonological analysis skills from

Grade 1 to Grade 2, although they did not include Matrices as a simultaneous measure. In general, they found less significant predictability among CAS processes for normal early development of reading. Parrila and Kirby (1998) state, "…rather than being linear, the effect of Successive processing on such simple reading tasks as Word Identification and Passage Comprehension may reach a plateau at some yet to be defined but probably relatively low threshold point. The same may well hold true for Attention and Simultaneous processing, although it seems less likely to be true for Planning" (p.4). The present study contrasted these results as Matrices, a simultaneous task, significantly predicted passage comprehension after nearly one full academic year. One possibility to explain the discrepancy between these findings is that the present sample of readers were more like beginning readers. It is conceivable that these readers had not yet reached this plateau that was postulated by Parrila and Kirby. The fact that the present sample had specifically been given help to improve their reading and cognitive skills may also have been a confounding variable. The added component of remediation may have mediated the present finding. However, as mentioned above, the consistency of this finding longitudinally to other studies that have found a relationship between reading comprehension and simultaneous measures lends support to this result.

Prediction of Word Probe. The Word Probe task was essentially an informal word identification task. It was found that a combination of Planned Connections and Figure Memory significantly predicted Word Probe results and accounted for 22% of the total variance. This finding is similar to Parrila and Kirby (1998) who found that Word Identification in Grade 1 was significantly predicted by Kindergarten planning ability. Although the present sample was considerably older (i.e., Grades 3 and 4), functionally they were performing closer to beginning readers. This may explain the similarity between these two studies. Simultaneous processing, on the other hand, was found to be only indirectly related to word identification over time by Parrila and Kirby.

Limitations of the present study

There were several major and some minor limiting factors in the present study. The first major limitation was the choice to utilize a group measure of reading ability rather than an individual test. As was mentioned previously, school staff did the first administration of the SDRT and it is highly likely that they failed to follow standardized administration procedures that resulted in a systematic bias that over-inflated the scores. The type of reading skills that were measured by the SDRT, although useful, failed to include the more traditional measures of phonetics such as Word Attack and also did not contain an individual word reading measure.

These two measures are more traditionally utilized in reading research that made direct comparisons more difficult.

A second major limitation was the rather small sample size (N=14 per group), which limited the types of analyses and the power of analyses. In particular, the present study was limited to ANOVA models as opposed to the more appropriate MANOVA models due to sample size restrictions. Small sample sizes are more particularly prone to the effects of outliers. The present sample was limited to Grades three and four. Therefore, it is difficult to know whether PREP would prove any more or less effective with children from other Grade levels.

The first minor limitation of the present study was the choice of experimental design. While the control-wait-list design can have utility, in that all subjects can potentially benefit from the intervention, the lack of a more formal control group for the entire time interval made it difficult to draw firm conclusions about the relative effectiveness of PREP. In addition, this study could have benefited from a control group from the mainstream cultural group. This would have allowed for more direct cross-cultural comparisons in order to analyze individual differences and similarities in cognitive functioning and response to PREP.

A second minor limitation of the present study was the utilization of a para-professional to administer PREP. While the individual who ran the remediation had been trained specifically in PREP, she was not formally trained as an educator and had limited teaching experience. The lack of trained remedial teachers has been a common criticism of remedial designs in the literature. Certainly, it could be argued that specific training in teaching techniques and principles could have an influence on the effectiveness of remediation. This would have to be tested more thoroughly.

A third minor limitation was the lack of communication and active participation from school personnel. While teachers were not openly against sending children for the remedial training, it became evident near the end of the research project that many teachers felt uninformed and perhaps somewhat resentful that they hadn't been more actively involved or consulted about the nature of the research project. All of the teachers understood that the children who were part of the study were receiving instruction that was aimed at helping their reading skills. However, there was no active communication with teachers about the nature of PREP. In addition, it was apparent that teachers were not necessarily encouraging the students to utilize the cognitive strategies they were learning in the PREP in the regular classroom.

A fourth and final limiting factor of the present research study has to do with sample selection. While efforts were made to ensure that no children with a history of disorders were included in the study, it is possible that some children in the present sample could have included some children who were diagnosable as Attention Deficit Disordered or Fetal Alcohol Effect. Given the difficulties in diagnosis for these disorders and the social stigma attached to them, there is often a lack of disclosure. The inclusion of children with these specialized learning problems could have significantly impacted results. Clearly, larger sample sizes and more stringent screening criteria could help alleviate this potential sampling problem in the future.

Suggestions for Future Research

As implied in the limitations section, there are several logical next steps in this research. First, it would be useful to retest the effectiveness of PREP with this sample. As is often the case with field research, many practical considerations get in the way of doing well-controlled research. If this study were to be replicated, under ideal circumstances, the researcher would be advised to utilize a larger sample that would receive PREP. In addition, it would be better to utilize an individual test of reading that includes individual word reading, several measures of phonological skills such as word attack, blending, and segmentation, as well as a comprehension measure. It would be useful to simultaneously test the effectiveness of PREP with a matched control group from a mainstream cultural school, and to run several PREP groups run by trained teachers and other PREP groups run by paraprofessionals who are trained in PREP but are not formally trained as educators. This would determine whether the level of expertise of the instructor has any significant effect on the effectiveness of PREP. As a last step for a replication study, it would be useful to more carefully screen children for such factors as ADHD and FAS prior to their entry in the research. Unfortunately, these problems are often difficult to detect or carry a social stigma that prevents disclosure.

It would be very useful to determine whether PREP would prove effective with native children from other tribal regions. As was pointed out by McShane and Berry (1988a; 1988b), there is considerable cultural diversity even within different native groups. These authors divide the many First Nations into 13 distinct cultural areas. The present sample are from the Cree First Nation that is considered part of a larger cultural group called plains natives. In addition to Cree the plains cultural group also includes such nations as Sioux, Dene, Navajo, Pawnee, Crow, Cheyenne, Comanche, Sarci, Blackfoot, etc. From a study by Katsuo (1987), we know that even amongst Cree, Dene and metis there can be considerable differences in learning styles and preferences. Therefore, one cannot assume that PREP would be equally effective for all native groups and would require replication with many different First Nations prior to knowing how effective it may be for any of these distinct cultural groups.

Culture was a variables that was not fully explored by this thesis. It would be interesting to more carefully examine how some of the cultural and social realities for reservation schools impact the development of reading. Some questions to be answered include: How do school and families create literacy environments for children? Are there differences in the valuing of education and reading in native communities? What influence does English as a second language have on the development of English language skills with natives? Some of these research questions could be answered in a more qualitative design where families are interviewed and their responses recorded and analyzed. Quantitative variables that could be included in such a study might be the number of books within the home, family stress levels, parental reading and education level, socio-economic status, history of residential schooling, and parenting practices and beliefs.

Given the reality that research and education are costly, it would be useful to test PREP with larger groups of children at a time. That is, PREP training could be adapted to work with groups of three to six students each. This would allow a single instructor to see more children per week which would increase overall group sizes and allow a researcher to perform statistics that can adequately test hypotheses.

Another logical next step in the research would be to test PREP with younger age groups. To date, most of the research has tended to focus on children in Grade 3 or above. If the PASS model holds correct, it seems reasonable to expect that the administration of PREP to young children and even pre-readers should help promote future reading success. Obviously, a downward extension of PREP would be required before this could be done.

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APPENDIX A

Letter to Parent

Dear Parent(s)/Guardian (s):

Hello, I am a psychologist who has been working in your school for the past year. As I'm still completing my doctoral degree I would like to share with you an exciting research project I'm conducting at Ermineskin school. I hope that after hearing about the possibilities this research offers, you will allow your child to participate.

The study I plan to do will require the participation of several grade 3 and 4 students from Ermineskin school. Essentially, I wish to take about 50 children from the school, some who are reading well and some who are struggling to read, and then assess their cognitive abilities. After this, about 24 children will be sent through a new remedial teaching program. The remedial program was designed by University Professor J.P. Das, and is designed to teach skills required for reading. It has already shown great success in improving reading skills and has even been tested successfully at Ermineskin school in 1974 by another graduate. Now I wish to test the revised edition of the remedial program to see how effective it is in improving reading skills in children with different reading abilities.

Each participant in this research will be required to participate in three things. First, all participants will have to be tested with an intelligence and cognitive ability test prior to entering the remedial program. This will involve about two hours of testing which will take place during regular class time. **Not all children tested will necessarily be placed in the remedial program.** Second, children selected for remediation will be placed through the remedial program which takes 15 hours to complete. Each child will get two hours of remedial teaching each week. Half of the children selected for the study will receive the remedial program now and half will get the program after Christmas. Third, once the children have gone through the remedial program, all will be tested once again for improvements in reading another important skills. The group that waits until after Christmas will also be tested for their changes over the school year prior to their entering the remedial program. Thus, a total of 4 hours of assessment and 15 hours a teaching will be required over the course of the year. All testing and teaching will be conducted at the school by qualified people. The results from this testing will be made available to any parent who requests it. All test information will be kept strict confidence.

I thank you in advance for considering his exciting research. If these requirements are acceptable to you and your child, and your child is willing to participate, please sign the attached consent form and returned to school along with a completed information form. Thank you for your cooperation.

If you have any questions or concerns regarding this research, please contact me at (403) 433 - 9743, or leave a note with the school so I can contact.

Troy Janzen, M.Ed., Chartered Psychologist

Consent Form

I__________________, having read and understood the attached description of this research, give my consent to have my child participate in this research. I understand that I or my child can choose to withdraw at anytime. Recognizing that this research is for educational purposes, I authorize school records regarding my child to be released to Troy Janzen, chartered psychologist. I understand that all information from this research project will become confidential. I also authorize information derived from this research to be used, where appropriate, for research purposes under the direction of the University academic staff member. Confidentiality of this information will be maintained at all times.

______________________________ ____________

Parent/Guardian Signature Date

______________________________ ____________

Child Signature Date

______________________________ ____________

Signature of Witness Date

Letter to Teachers

Dear grade 3 and 4 teachers,

hi! I'm a psychologist who has worked with children in the school since January of last year. This year, as part of my doctoral research, I'm planning to study reading ability among native children. To this and I am planning to assess and then remediation a number of grade 3 and 4 children from the school. What this will entail is some pretesting and then a 15 hour pullout remedial program. After some initial pretesting, I will select about 15 children to get the remedial program before Christmas, and 15 children for after Christmas.

To begin, I'm going to require an IQ measure for all grade 3 and 4 children. This means that I will be testing each grade 3 and 4 classroom with a group IQ measure. I'm planning to start Tuesday September 27 in the morning. Please indicate next to your name which time slot I can come to your class to do the testing on Tuesday or Wednesday.

Grade 3: TIME
Teacher Names Here ______________________________
____

Grade 4: TIME
Teacher Names Here ______________________________
____

After the group testing, I will be selecting about 15 children for individual testing. This means that these 50 children will be pulled out of class individually for about one hour of testing.

I will be available for any questions or concerns you have about this research. I hope to be able to present to the entire staff my research plans and explain more about the remedial program. I'm confident that with your help this remedial program will prove to be effective in improving reading skills. The remedial program has already shown to be effective in numerous other schools all over the world. I thank you for your help in this regard.

Yours sincerely,

Troy Janzen, Med., C.Psych.

APPENDIX B

Word Probe List of Words

List 1 A & B

1A

1 bee ______
2 map ______
3 fog ______
4 bag ______
5 rob ______
6 lap ______
7 job ______
8 pan ______
9 kid ______
10 tan ______
11 ham ______
12 bug ______
13 fed ______
14 cup ______
15 jet ______
16 men ______
17 add ______
18 mix ______
19 ant ______
20 yet ______
21 hall ______
22 less ______
23 pull ______
24 miss ______
25 sell ______
26 hand ______
27 will ______
28 back ______
29 wall ______
30 duck ______
31 just ______
32 kick ______
33 fact ______
34 jump ______
35 belt ______
36 plan ______
37 from ______
38 trap ______
39 frog ______
40 grab ______
41 crop ______

1A

42 skin ______
43 gift ______
44 club ______
45 hunt ______
46 sled ______
47 keep ______
48 tree ______
49 slow ______
50 stand ______
51 small ______
52 blast ______
53 spent ______
54 plant ______
55 crept ______
56 black ______
57 trick ______
58 drank ______
59 dash ______
60 ship ______
61 flash ______
62 round ______
63 crowd ______
64 like ______
65 snake ______
66 robin ______
67 that ______
68 zebra ______
69 then ______
70 mouse ______
71 them ______
72 house ______
73 thick ______
74 smart ______
75 think ______
TOTAL

1B

1 bad ______
2 top ______
3 fat ______
4 pig ______
5 pot ______
6 sat ______
7 fun ______
8 dig ______
9 cut ______
10 fox ______
11 red ______
12 run ______
13 beg ______
14 met ______
15 let ______
16 end ______
17 set ______
18 wax ______
19 sky ______
20 ask ______
21 tall ______
22 kiss ______
23 fell ______
24 sand ______
25 bull ______
26 pack ______
27 land ______
28 sack ______
29 dull ______
30 sick ______
31 cost ______
32 pick ______
33 soft ______
34 pond ______
35 test ______
36 must ______
37 best ______
38 bend ______
39 dust ______
40 send ______
41 desk ______

1B

42 sent ______
43 flat ______
44 tent ______
45 list ______
46 clap ______
47 went ______
48 drag ______
49 help ______
50 glad ______
51 drop ______
52 step ______
53 trip ______
54 stick ______
55 class ______
56 track ______
57 still ______
58 crack ______
59 spill ______
60 brick ______
61 stuff ______
62 truck ______
63 away ______
64 block ______
65 happy ______
66 grand ______
67 slept ______
68 sweet ______
69 swamp ______
70 chill ______
71 swift ______
72 chew ______
73 bring ______
74 hobby ______
75 brain ______
TOTAL

List 2 A & B

2A

1 deep ________
2 fool ________
3 heel ________
4 king ________
5 week ________
6 rang ________
7 slip ________
8 snow ________
9 hung ________
10 grow ________
11 sink ________
12 case ________
13 base ________
14 base ________
15 fine ________
16 hope ________
17 beat ________
18 dime ________
19 sail ________
20 meat ________
21 tail ________
22 thin ________
23 bath ________
24 wire ________
25 with ________
26 grass ________
27 clock ________
28 flash ________
29 broom ________
30 shake ________
31 speak ________
32 broke ________
33 train ________
34 seven ________
35 taste ________
36 table ________
37 beach ________
38 plate ________
39 cream ________
40 toast ________
41 faint ________

2A

42 feast ________
43 shape ________
44 thing ________
45 teeth ________
46 across ________
47 matter ________
48 cheese ________
49 sister ________
50 please ________
51 hotel ________
52 lucky ________
53 scout ________
54 skunk ________
55 grown ________
56 wrote ________
57 little ________
58 bubble ________
59 behind ________
60 ladder ________
61 sound ________
62 tooth ________
63 pound ________
64 metal ________
65 lunch ________
66 travel ________
67 candle ________
68 splash ________
69 stripe ________
70 bottom ________
71 stream ________
72 master ________
73 branch ________
74 choose ________
75 escape ________
TOTAL ☐

2B

1 till ________
2 meet ________
3 band ________
4 last ________
5 kill ________
6 boot ________
7 free ________
8 luck ________
9 hook ________
10 drum ________
11 blow ________
12 hang ________
13 date ________
14 lead ________
15 paid ________
16 each ________
17 save ________
18 meat ________
19 tank ________
20 rose ________
21 hate ________
22 woke ________
23 cave ________
24 size ________
25 main ________
26 doing ________
27 glass ________
28 spend ________
29 being ________
30 dress ________
31 green ________
32 brook ________
33 swing ________
34 crash ________
35 queen ________
36 apple ________
37 dream ________
38 maybe ________
39 never ________
40 reach ________
41 drive ________

2B

42 least ________
43 paint ________
44 sheet ________
45 leave ________
46 month ________
47 brown ________
48 snail ________
49 trunk ________
50 wheel ________
51 planet ________
52 supper ________
53 winter ________
54 yelled ________
55 window ________
56 coach ________
57 float ________
58 plain ________
59 mouth ________
60 waste ________
61 dinner ________
62 school ________
63 longer ________
64 number ________
65 silver ________
66 summer ________
67 strong ________
68 puddle ________
69 showed ________
70 passed ________
71 string ________
72 struck ________
73 played ________
74 twelve ________
75 freeze ________
TOTAL ☐

List 3 A & B

3A
1 alike ______
2 fifty ______
3 jelly ______
4 penny ______
5 press ______
6 begin ______
7 cabin ______
8 marry ______
9 enjoy ______
10 lower ______
11 three ______
12 enter ______
13 study ______
14 drove ______
15 cheek ______
16 allow ______
17 organ ______
18 power ______
19 reply ______
20 sixty ______
21 became ______
22 yellow ______
23 letter ______
24 happen ______
25 rattle ______
26 waited ______
27 forgot ______
28 during ______
29 tunnel ______
30 really ______
31 inside ______
32 recess ______
33 breeze ______
34 record ______
35 coffee ______
36 valley ______
37 carrot ______
38 throat ______
39 jungle ______
40 choose ______
41 scream ______

3A
42 nobody ______
43 squeak ______
44 carpet ______
45 reason ______
46 danger ______
47 cherry ______
48 escape ______
49 gentle ______
50 admire ______
51 without ______
52 morning ______
53 address ______
54 fifteen ______
55 forever ______
56 kitchen ______
57 mistake ______
58 stretch ______
59 squeeze ______
60 destroy ______
61 simple ______
62 expect ______
63 teacher ______
64 rainbow ______
65 careful ______
66 exactly ______
67 foolish ______
68 surface ______
69 general ______
70 thunder ______
71 perfect ______
72 explain ______
73 husband ______
74 hamster ______
75 captain ______
TOTAL ☐

3B
1 today ______
2 fresh ______
3 again ______
4 under ______
5 began ______
6 below ______
7 paper ______
8 awake ______
9 event ______
10 match ______
11 alive ______
12 april ______
13 fifth ______
14 truth ______
15 often ______
16 order ______
17 arrow ______
18 model ______
19 bunch ______
20 child ______
21 better ______
22 safely ______
23 rabbit ______
24 become ______
25 robber ______
26 bother ______
27 saving ______
28 keeper ______
29 softly ______
30 purple ______
31 rather ______
32 beaver ______
33 ticket ______
34 ground ______
35 twenty ______
36 pencil ______
37 church ______
38 invite ______
39 lonely ______
40 sudden ______
41 doctor ______

3B
42 toward ______
43 hidden ______
44 rocket ______
45 itself ______
46 famous ______
47 unless ______
48 season ______
49 manage ______
50 rescue ______
51 chance ______
52 switch ______
53 yelling ______
54 grandma ______
55 welcome ______
56 sixteen ______
57 between ______
58 evening ______
59 silence ______
60 quickly ______
61 contest ______
62 package ______
63 exclaim ______
64 airport ______
65 suppose ______
66 forward ______
67 against ______
68 diamond ______
69 promise ______
70 monster ______
71 costume ______
72 hundred ______
73 pretend ______
74 pitcher ______
75 startle ______
TOTAL ☐

Appendix C

The following contains additional analyses and discussion not included in the main body of the text. These analyses are placed here as they were mainly exploratory and did not address the research hypotheses of interest for the present dissertation.

CAS vs. CTCS

The relationship between the more traditional IQ measure, namely CTCS, and the CAS was also performed. The Informal Word Probe was also included in this analysis. Scaled scores from the CTCS were used while raw scores were used from the CAS and the Word Probe. These results are presented in Table C1

Table C1

Pearson product moment correlations between CAS, CTCS and Word Probe (N=43)

Variables	CSI	Memory	Sequences	Analogies	Non-Verbal	Verbal Reasoning	Total
Word Series	.37 p=.02	n.s.	.28 p=.069	n.s.	.27 p=.086	.32 p=.04	.30 p=.057
Speech Rate	n.s.	n.s.	-.29; p=.064	n.s.	n.s.	n.s.	n.s.
Figure Memory	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Matrices	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Expressive Attention	n.s.	n.s.	n.s.	-.28 p=.07	n.s.	n.s.	n.s.
Planned Connections	-.38 p=.01	n.s.	n.s.	-.38 p=.012	-.44 p=.003	n.s.	n.s.
Word Probe	.53 p=.00	n.s.	.49 p=.001	.58 p=.00	.59 p=.000	.44 p=.003	.58 p=.000

Note: n.s. indicates not significant or p>.10

From Table C1 we can see that the Word Series and the Word Probe tests had the most significant correlations with CTCS subtests. Word Series correlated significantly with the overall CSI or IQ index, as did Word Probe and Planned Connections. The Analogies subtest of the

CTCS also correlated significantly with Expressive Attention and Planned Connections. It should be noted that the simultaneous tasks (i.e., Figure Memory & Matrices) were not significantly correlated with any of the CTCS measures. As one might expect, the Sequences subtest of the CTCS correlated at near significant levels with the Successive processing tasks of Word Series and Speech Rate.

The many significant findings with Word Series may have to do with the high degree of variability in Word Probe results. For this reason, the analysis was carried out again, this time using Spearman rank order calculations. Only two of the previous significant results using Pearson correlations failed to reach significance when using Spearman rank order correlations. That is, Word Probe did not correlate significantly with either the Memory or the Verbal Reasoning subtests when relative rank-order correlations were used. All of the remaining correlations maintained their level of significance $p<.01$.

CAS inter-correlations over time and Remediation

Presented in Table C2 are the significant ($p<.10$) inter-correlations among CAS variables at all three time periods. Only significant correlations are reported as 72 correlations were calculated in total. From this Table we can see that nearly half of these were significant and for the most part significant correlations occurred where expected. That is, it was expected that inter-correlations of like-subtests across time would generally show significant positive correlations. This is generally what was found. However, there were several counter-intuitive and interesting findings worthy of note. First, Planned Connections at Time 1 was significantly negatively correlated with both Figure Memory at Time 2 and positively correlated with Expressive Attention at Time 3. Also, Figure Memory scores at Time 1 and Time 2 were significantly negatively correlated with Planned Connections at Time 3. In other words, those who were better planners, but had poorer memory for figures, tended to be better at planning ability following remediation. This result was somewhat surprising as these tests, which are purported to be measures of distinct constructs, are expected to show a weak relationship with each other. The fact that these correlations occurred over a time interval, and with remediation over the interval, may suggest that planning ability is implicated in predicting success on the simultaneous task of Figure Memory following remediation and vice versa.

A second general finding of interest from Table C2 was the fact that timed subtests (Planned Connections, Expressive Attention, and Speech Rate) tended to be positively and significantly inter-correlated. There were a number of significant correlations between Expressive Attention and Speech Rate and Planned Connections at the various time intervals.

Table C2

Significant Inter-correlations (p<.10) of CAS Variables at all three Time Periods.

Variable 1	Variable 2	r	p
Expressive Attention Time 1	Expressive Attention Time 2	0.656	0.000
Expressive Attention Time 1	Expressive Attention Time 3	0.584	0.001
Expressive Attention Time 2	Expressive Attention Time 3	0.680	0.000
Expressive Attention Time 2	Speech Rate Time 2	0.557	0.003
Expressive Attention Time 3	Planned Connections Time 3	0.380	0.046
Expressive Attention Time 3	Speech Rate Time 3	0.463	0.013
Figure Memory Time 1	Figure Memory Time 2	0.461	0.015
Figure Memory Time 1	Planned Connections Time 3	-0.400	0.035
Figure Memory Time 2	Planned Connections Time 3	-0.459	0.016
Figure Memory Time 2	Matrices Time 3	0.509	0.007
Figure Memory Time 2	Figure Memory Time 3	0.610	0.001
Matrices Time 1	Figure Memory Time 1	0.511	0.005
Matrices Time 1	Matrices Time 2	0.389	0.045
Matrices Time 1	Figure Memory Time 2	0.461	0.015
Matrices Time 1	Matrices Time 3	0.510	0.006
Matrices Time 2	Word Series Time 3	0.405	0.036
Planned Connections Time 1	Planned Connections Time 2	0.676	0.000
Planned Connections Time 1	Figure Memory Time 2	-0.384	0.048
Planned Connections Time 1	Planned Connections Time 3	0.538	0.003
Planned Connections Time 1	Expressive Attention Time 3	0.418	0.027
Planned Connections Time 2	Planned Connections Time 3	0.651	0.000
Planned Connections Time 2	Expressive Attention Time 3	0.380	0.046
Speech Rate Time 1	Speech Rate Time 2	0.405	0.036
Speech Rate Time 1	Speech Rate Time 3	0.754	0.000
Speech Rate Time 2	Expressive Attention Time 3	0.466	0.014
Speech Rate Time 2	Speech Rate Time 3	0.704	0.010
Word Series Time 1	Matrices Time 2	0.413	0.032
Word Series Time 1	Word Series Time 2	0.831	0.000
Word Series Time 1	Word Series Time 3	0.821	0.000
Word Series Time 3	Word Series Time 2	0.834	0.000

ANOVA Results with Change Statistics

ANOVA Based on Vocabulary Groupings

Presented below in Table C3 are the one-way ANOVA results for the Time intervals not discussed in the dissertation. There was a highly significant ANOVA result for Auditory Vocabulary change scores from Time 1 to Time 2. Bonferroni post-hoc analysis revealed that the Average Vocabulary Group had significantly (p<.01) poorer change scores (Change Score=-53.3) than either the Poor Group (Change score=1.2) and the Very Poor Group (Change Score=30.6). As can be seen, the Average group in fact lost ground from Time 1 to Time2 while the Poor and Very Poor Groups made mild to moderately positive changes. This result is in direct contrast to what Matthew effects would have predicted. There was also a significant difference for the

Phonetic Analysis change scores from Time 1 to Time 2. Bonferroni post-hoc analysis revealed that the there was a significant difference (p=.044)between the Poor Vocabulary Group (Change score=-1) and the Average Vocabulary Group (Change score=-73.7). The Very Poor Vocabulary group (Change Score=-2) was not statistically significant from either group but did approach significance when compared to the Average Group (p=.096).

Table C3

One-Way ANOVA for Vocabulary Groups with SDRT Change scores

Variable	Source	Sum of Squares	df	MS	F
	Time 3 minus Time 2 Change Scores				
Auditory Discrimination	Between	994.8	2	497.4	.224
	Within	53171.9	24	2215.5	
Auditory Vocabulary	Between	2982.8	2	1491.4	2.943
	Within	12161.7	24	506.7	
Phonetic Analysis	Between	3169.0	2	1584.5	.93
	Within	40870.8	24	1703.0	
Total Comprehension	Between	10035.6	2	5017.8	1.541
	Within	68381.8	24	3256.3	
	Time 2 minus Time 1 Change Scores				
Auditory Discrimination	Between	8514.4	2	4257.2	.874
	Within	116877.2	24	4869.9	
Auditory Vocabulary	Between	25680.2	2	12840.1	10.699**
	Within	28803.5	24	1200.1	
Phonetic Analysis	Between	27157.2	2	13578.6	3.909*
	Within	83361.4	24	3473.4	
Total Comprehension	Between	6459.1	2	3229.6	.832
	Within	85413.1	24	3882.4	

Note: *p<.05; **p<.01

For Time 3 minus Time 2, the only near significant ANOVA result occurred for Auditory Vocabulary change scores. Bonferroni post-hoc analysis revealed that the Average group (Change Score=37.5) had a nearly significant difference (p=.087) when compared to change scores from the Poor group (Change Score=7.8).

Findings from SDRT change scores from Time 2 to Time 3 generally support the popular notion of Matthew Effects (Stanovich, 1986). This notion refers to the idea that those who are relatively stronger will have an instructional advantage over those who begin with weaker ability. Thus, a rich get richer and poor get poorer philosophy is espoused. From this table we know that Group 1 and 2 showed general trends towards improvement in SDRT scores from Time 2 to Time 3. Further, we know that the average improvement in terms of standard scores was about the same for both groups. In fact, Group 1 even showed greater improvement in SDRT scores than Group 2 for Auditory Discrimination, Phonetics and Total Comprehension. This finding took place despite the fact Group 2 received PREP over this time frame.

Table C3 shows that those who are quite poor in terms of Auditory Vocabulary at Time 1 gain the least from Time 2 to Time 3. Conversely, those who are average in terms of vocabulary at Time 1 gain the most from Time 2 to Time 3. Given that these groups were matched for vocabulary from the beginning, this suggests that those who were the very weakest in Auditory Vocabulary (i.e., performing below the 5th percentile) were the least likely to benefit from PREP or show improvement in reading ability.

Correlational Analysis

The next question of interest is how are CAS, SDRT, and demographic variables related to one another? Several different correlational analyses were conducted to address the nature of these relationships. These analyses serve as a precursor to the more specific question of what variables are the best predictors of successful reading remediation utilizing PREP. For this section, Pearson product-moment correlations were calculated for a variety of combinations of variables. All correlations were calculated using standardized variables, with the exception of Word Probe where no normative data was available. As the correlational analysis resulted in a vast array of statistics, only those correlations that had a probability value of less than 0.10 (two-tailed) are reported here.

Presented in Table C4 are all the significant correlations between demographic and grouping variables and all other variables over all time periods. From this table there are several findings worthy of note. First, age tended to be most strongly related with scores on the Matrices subtest. However, this relationship was negative for Matrices scores at Time 1 and positive in relation to the amount of change in score from Time 1 to Time 3 and from Time 1 to Time 2. In other words, older children tended to score higher on Matrices at Time1 but younger children tended to show a larger magnitude of improvement in Matrices over time. A second finding of interest was that there were negative correlations between age and both Expressive Attention scores at Time 2 and Figure Memory scores at Time 1. These correlations seem counter-intuitive, as one would expect older children to outperform younger peers. A third finding of interest was in terms of change scores. Age was positively correlated with changes in Matrices scores over time as was reported above. However, age showed a negative correlation with the change in Word Series scores from Time 2 to Time 3. Put another way, older children tended to have smaller magnitude changes in Word Series scores than younger children. For this test it is possible that ceiling effects may have contributed to this finding.

Table C4

Significant Correlations (p<.10) Between Demographic and Grouping Variables with all other Variables.

Variable 1	Variable 2	r	p
Age	Expressive Attention Time 2	-0.353	0.071
Age	Matrices Time 1	-0.444	0.018
Age	Figure Memory Time 1	-0.330	0.087
Age	Auditory Vocabulary Time 3	0.335	0.088
Age	Matrices 3_1	0.507	0.006
Age	Word Series 3_2	-0.354	0.070
Age	Matrices 2_1	0.374	0.054
CSI	Expressive Attention 3_2	0.497	0.016
CSI	Matrices 2_1	0.432	0.040
CSI	Matrices Time 2	0.451	0.031
CSI	Auditory Discrimination Time 2	0.429	0.041
CSI	Auditory Vocabulary Time 2	0.531	0.009
Gender (1= boys, 2=girls)	Figure Memory Time 3	-0.429	0.023
Group	Figure Memory Time 3	-0.500	0.008
Low and High Comprehension	Phonetic Analysis 3_1	-0.504	0.007
Low and High Comprehension	Total Comprehension 3_1	-0.517	0.006
Low and High Comprehension	Speech Rate Time 2	0.426	0.027
Low and High Vocabulary	Low and High Comprehension	0.399	0.035
Low and High Vocabulary	Auditory Vocabulary 3_1	-0.494	0.009
Low and High Vocabulary	Auditory Vocabulary 3_2	0.443	0.021
Low and High Vocabulary	Word Series Time 3	0.448	0.017
Phonetic Analysis 3_1	Total Comprehension 3_1	0.521	0.000
Phonetic Analysis 3_2	Total Comprehension 3_2	0.570	0.000
Total Comprehension 3_1	Total Comprehension 3_2	0.620	0.000

In continuing to examine Table C4 we find several other findings worthy of note. First, CSI tended to be positively correlated with variables only at Time 2. That is, the only significant correlations occurred between CSI and SDRT and CAS variables at Time 2. As CSI is a more traditional IQ measure and contains a subtest that is roughly akin to the Matrices subtest, the positive correlation between CSI and Matrices was expected. Higher scorers on CSI were also associated with greater magnitude changes on Expressive Attention and Matrices over time.

In terms of the discrete variables, such as gender and grouping variables, there were several contradictory findings worthy of note. First, there was a negative correlation between pre-vocabulary level (Low and high vocabulary) and the change in vocabulary scores from Time 1 to Time 3. However, this relationship was reversed from Time 2 to Time 3. In other words, people higher in vocabulary ability at pretest tended to have less gains in vocabulary from Time 1 to Time 3. However, from Time 2 to Time 3, subjects with a higher vocabulary at pretest had greater gains in vocabulary. This seemingly contradictory finding may be the result of a systematic bias in the Time 1 vocabulary scores.

In terms of change statistics, as shown in Table C4, the results suggest that subjects who had lower reading comprehension scores at Time 1 made greater gains in Phonetic Analysis and Total Comprehension from Time 1 to Time 3. Also, subjects who made positive gains on the Phonetic Analysis subtest from Time 1 to Time 3 also tended to make positive gains on Total Comprehension over the same time period as well as from Time 2 to Time 3. Finally, subjects who made strong gains in Total Comprehension scores from Time 1 to Time 3 were related to strong gains from Time 2 to Time 3 on the same subtest.

Presented below in Table C5 are the significant (p<.10) inter-correlations between standardized CAS scores and SDRT standard scores over all three time periods. There were several significant findings in this table. First, Expressive Attention scores tended to be negatively correlated with Auditory Vocabulary and Auditory Discrimination but positively correlated with Phonetic Analysis over time. That is, those who performed well on the Expressive Attention task at Time 1 tended to do relatively poorly on the Auditory Vocabulary task at Time 3, after the intervention. Conversely, those who performed well on the expressive Attention task at Time 1 tended to also score relatively high on the Phonetic Analysis task at Time 2.

In looking more closely at the results in Table C5, there were three significant findings that involved CAS variables at Time 1 and SDRT variables at Time 3. Given the relative position in time and given that CAS variables are postulated to be higher order factors, these findings may speak directly to the question of predictability. First, Auditory Vocabulary scores at Time 3 were significantly positively correlated with both Word Series (p=.067) and Figure Memory (p=.056) at Time 1. This indicates that those who performed well on the successive task of Word Series and the simultaneous task of Figure Memory, tended to show better performance on Auditory Vocabulary after the administration of PREP and the passage of time. Conversely, as was previously mentioned, Time 1 Expressive Attention scores were significantly negatively correlated with Auditory Vocabulary scores at Time3. Therefore, this suggests that those students, who performed well on successive and simultaneous tasks, but relatively poorly on

Expressive Attention, were most likely to show good performance on Auditory Vocabulary after they received PREP.

Table C5

Significant Correlations (p<.10) between CAS and SDRT Variables over all 3 Time Periods.

Variable 1 (CAS)	Variable 2 (SDRT)	r	p
Expressive Attention Time 1	Phonetic Analysis Time 2	0.387	0.046
Expressive Attention Time 1	Auditory Vocabulary Time 3	-0.468	0.014
Expressive Attention Time 2	Auditory Discrimination Time 2	-0.551	0.003
Expressive Attention Time 2	Auditory Vocabulary Time 3	-0.461	0.015
Figure Memory Time 1	Auditory Discrimination Time 1	0.378	0.047
Figure Memory Time 1	Auditory Vocabulary Time 3	0.372	0.056
Figure Memory Time 2	Auditory Discrimination Time 1	0.363	0.063
Figure Memory Time 2	Auditory Discrimination Time 2	0.347	0.076
Figure Memory Time 2	Total Comprehension Time 3	0.561	0.003
Figure Memory Time 3	Total Comprehension Time 3	0.361	0.070
Matrices Time 1	Auditory Vocabulary Time 1	-0.326	0.090
Matrices Time 1	Total Comprehension Time 3	0.544	0.004
Matrices Time 2	Auditory Discrimination Time 1	0.415	0.031
Matrices Time 2	Total Comprehension Time 3	0.391	0.048
Matrices Time 3	Total Comprehension Time 3	0.548	0.009
Planned Connections Time 1	Auditory Vocabulary Time 1	0.335	0.081
Speech Rate Time 1	Auditory Vocabulary Time 1	0.367	0.055
Speech Rate Time 1	Phonetic Analysis Time 3	0.476	0.012
Speech Rate Time 2	Total Comprehension Time 1	0.465	0.014
Speech Rate Time 3	Phonetic Analysis Time 1	0.407	0.032
Speech Rate Time 3	Total Comprehension Time 1	0.323	0.094
Speech Rate Time 3	Phonetic Analysis Time 3	0.324	0.099
Word Series Time 1	Auditory Discrimination Time 1	0.350	0.068
Word Series Time 1	Phonetic Analysis Time 3	0.431	0.025
Word Series Time 1	Auditory Vocabulary Time 3	0.357	0.067
Word Series Time 2	Auditory Discrimination Time 1	0.455	0.017
Word Series Time 2	Auditory Discrimination Time 2	0.326	0.097
Word Series Time 2	Phonetic Analysis Time 3	0.465	0.014
Word Series Time 2	Auditory Vocabulary Time 3	0.346	0.078
Word Series Time 3	Auditory Discrimination Time 1	0.497	0.007
Word Series Time 3	Auditory Vocabulary Time 1	0.426	0.024
Word Series Time 3	Phonetic Analysis Time 3	0.482	0.011
Word Series Time 3	Auditory Vocabulary Time 3	0.407	0.035

A second finding was that Time 1 Matrices was significantly positively correlated with Time 3 Comprehension scores. In fact, Matrices was the only Time 1 CAS subtest that showed a significant correlation with Total Comprehension over this time interval. This suggests that those who were relatively stronger on Matrices before PREP showed stronger reading comprehension skill after PREP was administered.

A third finding was that Phonetic Analysis scores at Time 3 were significantly positively correlated with the successive tasks of Speech Rate and Word Series at Time 1. This suggests that those who were already relatively stronger in terms of successive ability prior to PREP tended to perform better on a phonetic analysis task after PREP.

A fourth finding from Table C5 was a negative correlation found between Matrices and Auditory Vocabulary at Time 1. This correlation approached significance (p= .09). This finding appeared somewhat contradictory as one might expect a positive relationship between these variables, as Matrices is very similar in nature to Raven's Progressive Matrices, which is commonly used as a measure of non-verbal intelligence and is espoused as a relatively culture-fair test. Since we know that Raven's version of this test has shown positive relationship with achievement (.30 to .60s) and other more traditional intelligence tests (.50s to .80s), it seems reasonable to expect a similar positive finding here (Sattler, 1990). Perhaps this finding is specific to this population or may be a spurious finding.

To more closely examine the relationship between CAS subtests and the degree of overall change in reading ability, correlations were calculated between CAS scores and SDRT change statistics. The significant (p<.10) results are presented below in Table C6. Of interest here is that a majority of the significant correlations were negative, indicating that high scores on CAS variables tended to be related to low or negative change scores. One exception to this was the correlation between Matrices at Time 1 and the change scores for Total Comprehension. This correlation was significant and positive indicating that high scorers on Matrices at Time 1 tended to have higher or more positive changes in terms of their reading comprehension ability after receiving PREP.

Table C6

Significant Correlations (p<.10) between SDRT Change Statistics from Time1 to Time 3 and CAS Statistics at all 3 Time Periods.

CAS Statistics	SDRT Change Statistics (Time 1 to Time 3)	r	p
Figure Memory Time 1	Auditory Discrimination 3_1	-0.329	0.094
Word Series Time 1	Auditory Discrimination 3_1	-0.541	0.004
Word Series Time 2	Auditory Discrimination 3_1	-0.499	0.008
Word Series Time 3	Auditory Discrimination 3_1	-0.604	0.001
Planned Connections Time 1	Auditory Vocabulary 3_1	-0.367	0.060
Planned Connections Time 2	Auditory Vocabulary 3_1	-0.334	0.088
Expressive Attention Time 3	Auditory Vocabulary 3_1	-0.387	0.046
Speech Rate Time 3	Phonetic Analysis 3_1	-0.349	0.074
Word Probe Time 1	Total Comprehension 3_1	-0.392	0.048
Matrices Time 1	Total Comprehension 3_1	0.465	0.017
Figure Memory Time 2	Total Comprehension 3_1	0.392	0.048
Word Probe Time 2	Total Comprehension 3_1	-0.394	0.046
Matrices Time 3	Total Comprehension 3_1	0.510	0.008
Word Probe Time 3	Total Comprehension 3_1	-0.452	0.019

Correlation Results Summary

- Correlational analyses showed that CAS subtests were significantly inter-correlated over time as expected. That is, like-subtests showed high and positive correlations over time. Also, all timed subtests (Planned Connections, Expressive Attention and Speech Rate) tended to be significantly positively correlated
- CSI was not significantly correlated with any of the CAS variables at Time 1. This may add to the differential validity of the CAS.
- At Time 1 there were several significant correlations between CAS and SDRT variables. First, Figure Memory and Word Series were both significantly positively correlated with Auditory Discrimination. Second, Matrices, Planned Connections, and Speech Rate were all significantly correlated with Auditory Vocabulary. However, the correlation for Matrices was negative while the correlations for both Planned Connections and Speech Rate were positive.

In the body of the thesis, only significant correlations between Time 1 CAS subtests and Time 3 reading measures were presented. Therefore, the entire correlation matrix is presented in Table C7. From this table it can be seen that there was generally weak relationships between CAS subtests and Reading measures over time. The only near significant result not reported in the body of the thesis was that Speech Rate was nearly significantly correlated with Phonetic Analysis.

Table C7

Pearson Product Moment Correlations (N=27) between Time 1 CAS Subtests and Time 3 Reading Measures.

	ADSS3	PHSS3	AVSS3	TCSS3	WPROBE3
MAT1	.118	.148	.108	.591**	.086
PLAN1	-.134	-.155	-.245	.113	-.273
FIGMEM1	.382*	.070	.502**	.297	.234
EXATTN1	-.056	.062	.180	.024	-.290
SPRT1	.005	-.344	-.305	-.063	-.070
WSER1	-.036	.390*	.395*	.166	.078

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).